

United States  
Department of  
Agriculture

Forest Service

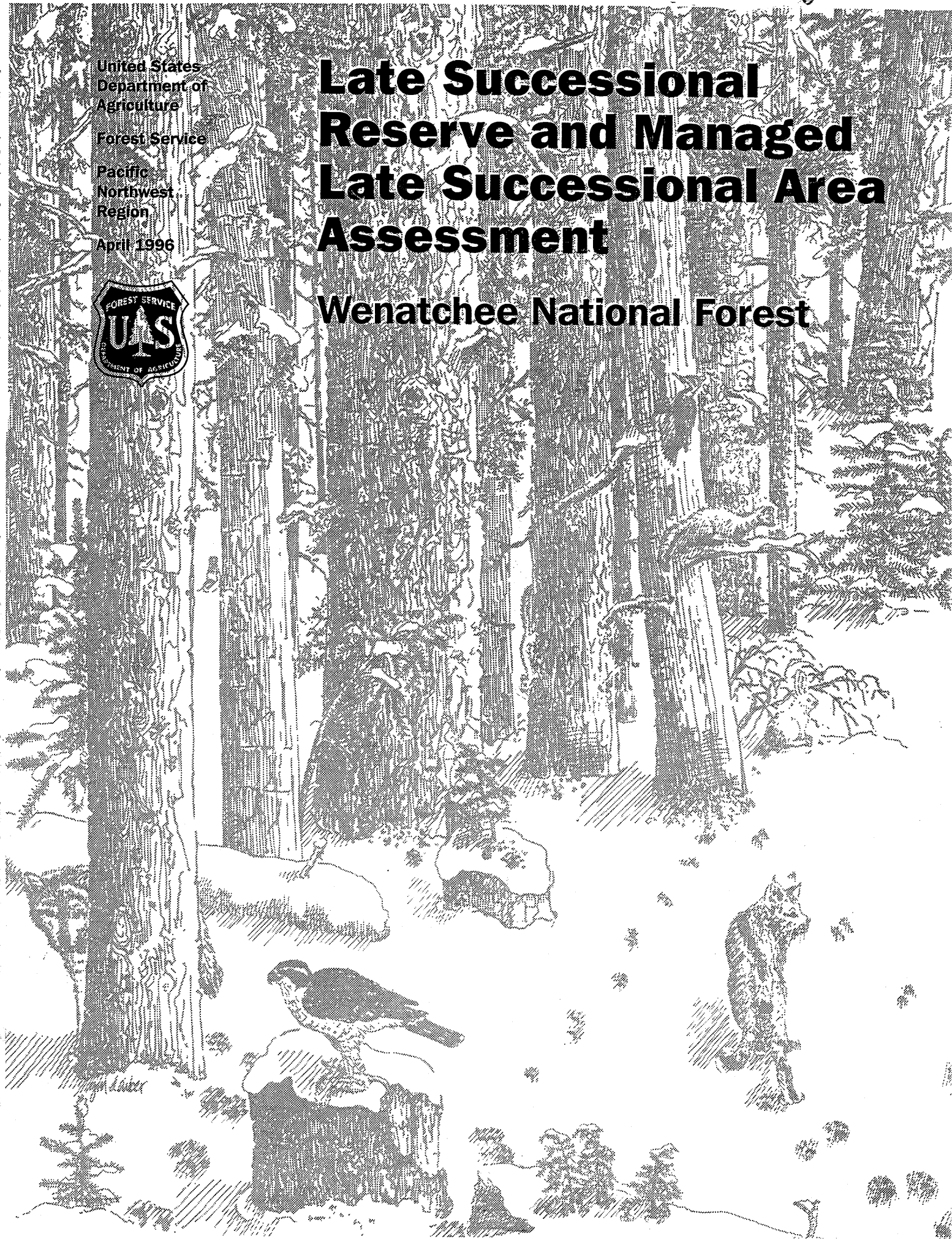
Pacific  
Northwest  
Region

April 1996



# Late Successional Reserve and Managed Late Successional Area Assessment

## Wenatchee National Forest



# REGIONAL ECOSYSTEM OFFICE

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## MEMORANDUM

DATE: September 16, 1996

TO: Robert W. Williams, Regional Forester, Region 6 Forest Service

FROM: Donald R. Knowles, Executive Director

*Don Knowles*

SUBJECT: Regional Ecosystem Office Review of the Forest-wide Wenatchee National Forest Late Successional Reserve and Managed Late Successional Area Assessment, as well as Specific Assessments for the following:

### Late-Successional Reserves

Chiwawa LSR  
Manastash Ridge LSR  
Shady Pass LSR  
Swauk LSR  
Upper Nile LSR

### Managed Late-Successional Areas

Haystack MSLA  
Milk Creek MSLA

### Summary:

The Regional Ecosystem Office (REO) and the Interagency Late-Successional Reserve Work Group have reviewed the Wenatchee National Forest Late-Successional Reserve and Managed Late-Successional Area Assessments (LSRAs)<sup>1</sup> including specific assessments for Chiwawa Late-Successional Reserve (LSR), Haystack Managed Late-Successional Area Assessment (MLSA) and Upper Nile LSR, Milk Creek MLSA, Shady Pass LSR, Swauk LSR, and Manastash Ridge LSR. The REO finds that the LSRAs and MLSAs provide a sufficient framework and context for future projects and activities within the LSRs<sup>2</sup>. Future silvicultural activities described in the LSRAs/MLSAs that meet the criteria and objectives described in the LSRAs/MLSAs and that are consistent with the Standards and Guidelines (S&Gs) in the Northwest Forest Plan (NFP), are exempted from subsequent project-level REO review.

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<sup>1</sup>Following the **Summary**, and for ease of reference, the late-successional reserve *assessments* and managed late-successional area *assessments* will be individually and collectively referred to as LSRAs.

<sup>2</sup>Following the **Summary**, and for ease of reference, the late-successional reserves and managed late-successional areas will be individually and collectively referred to as LSRs.

### Review of the Assessment

The REO reviewed the LSRAs in light of the eight subject areas from the NFP. Each LSRA discusses vegetative conditions, connectivity with other LSRs, unique habitats and species, habitat for the northern spotted owl, human uses, disturbance risk, and known information regarding noxious weeds. In addition, each individual LSRA includes a fire management plan, a summary of restoration opportunities, and potential projects intended to reduce the risk of high intensity fire and to achieve or maintain desired late-successional conditions. These potential projects include precommercial and commercial thinning in dry and moist forest groups to reduce fire and insect risk and accelerate development of late-successional conditions; thinning to reduce spread of mountain pine beetles in young lodgepole pine stands; pruning to disrupt linkages between ground and crown fuels to increase the effectiveness of roads as fuel breaks; prescribed fire within dry forest types; and removing conifers encroaching on natural meadows. The LSRAs do not address potential salvage activities.

Within the overview document and the individual LSRAs, there are descriptions of current and historical conditions, along with detailed discussions of their differences and management implications. This comparison, modified by habitat needs of late-successional dependent species, was used to identify desired future conditions consistent with the objectives for managing LSRs. As a result, the LSRAs link desired late-successional habitat conditions with actions needed to provide short and long term sustainability.

The REO is working the Research and Monitoring Committee to ensure that projects within LSRs, including projects exempted from REO review, are considered in the development of the implementation, effectiveness and validation monitoring program.

### Assumptions

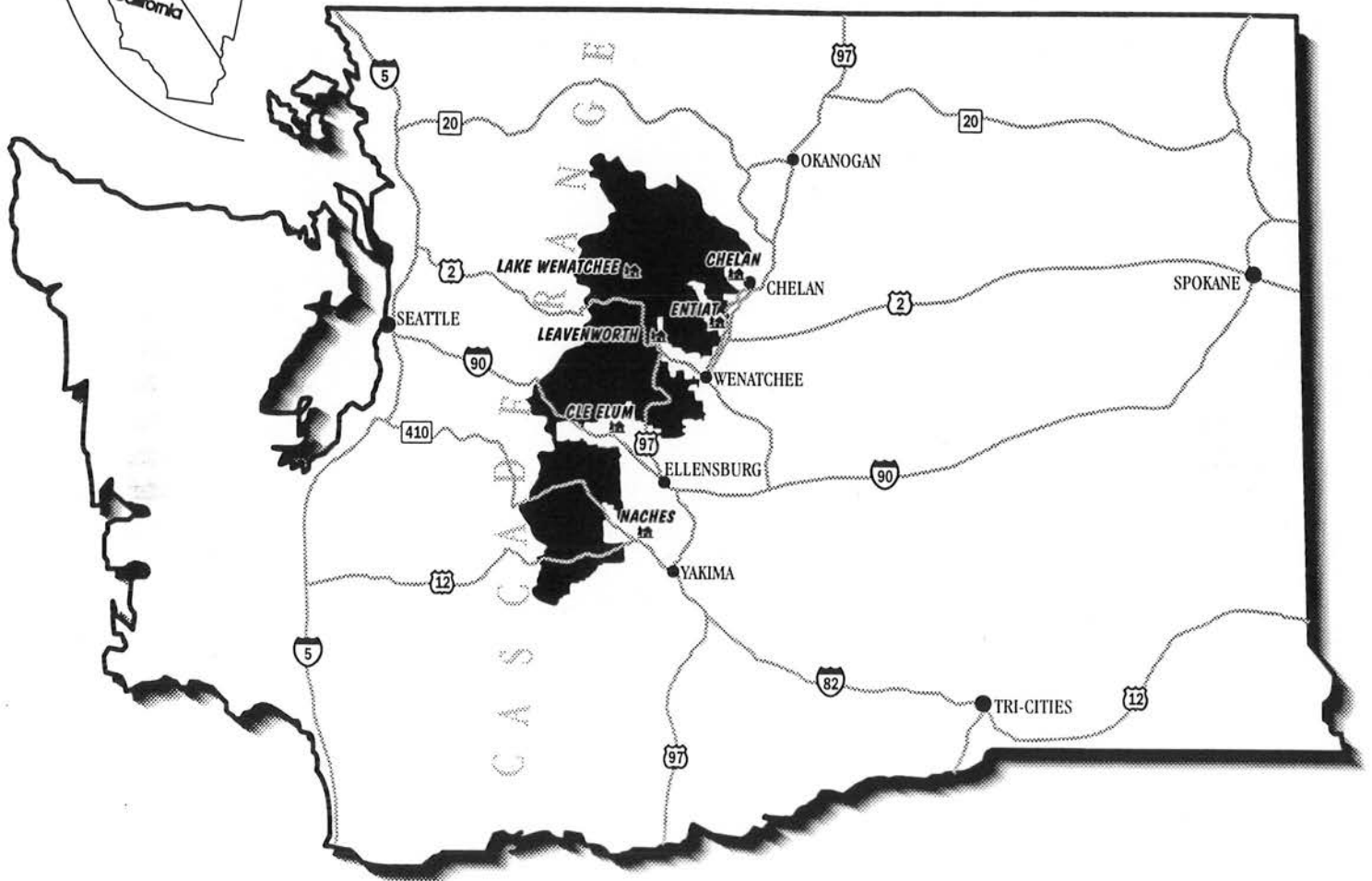
1. The additional information provided by the Wenatchee National Forest during the REO review was essential to understanding the assessments. The REO assumes that this clarifying information will be incorporated into the assessment documents<sup>3</sup>.
2. Potential projects within several LSRAs include "conduct activities that improve the effectiveness of the existing road system as fuelbreaks." From discussions with Wenatchee staff, this activity includes pruning and removal of forest fuels adjacent to roads to disrupt linkages between ground and crown fuels. The REO assumes, and it was verified in discussions with Wenatchee staff, that this action will be applied only in limited situations where it will substantially reduce the risk of losing a significant acreage of late-successional forest.

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<sup>3</sup>In addition to the LSRAs, the forest submitted: narrative clarifying the differences between desired ecological conditions, desired biological conditions, and desired future conditions; an updated version of Table 17, which summarizes desired conditions for snags, green tree replacements, and coarse woody debris; and a document titled "Additional Detail on Treatment Options, Diagnostic Criteria for Treatment Selection, and Anticipated Post-treatment Results."

# VICINITY MAP

## WENATCHEE NATIONAL FOREST



W A S H I N G T O N

 **RANGER DISTRICT OFFICE**

# Executive Summary

## Background

In 1994 the Northwest Forest Plan (NWFP) initiated a Regional "Late Seral" network to help maintain the viability of species associated with older forests. To help achieve this the NWFP requires the Forest Service and Bureau of Land Management to prepare assessments for each of the Late Successional Reserves (LSR) and Managed Late Successional Areas (MLSA). These assessments analyze the condition of the LSR/MLSA, determine how to protect and enhance late successional old growth forest ecosystems and determine what activities are consistent with the NWFP Record of Decision's Standards and Guidelines. These assessments provide information, not decisions, for Forest plan amendments, site specific projects, and restoration and monitoring needs for the management of the Late Successional Reserves.

In November of 1995, the Wenatchee National Forest's Forest Leadership Team made a decision to form a "Forest LSR Assessment Team" to prepare, as part of a single assessment project, assessments for all "high risk" LSR/MLSA's on the forest. These LSR/MLSA's were identified as "high risk" of losing late successional habitat from fire events in the "Late-Successional Reserve Standards and Guidelines for Wenatchee National Forest in the Eastern Washington Cascades and Yakima Provinces, Interim Direction", 1995). This grouping of assessments would provide several benefits:

1. It would provide timely direction for a variety of proposed activities responding to the forest's emphasis on "Dry Site Strategy", a critical management issue;
2. Not only would it assess the individual LSR/MLSA but it would also effectively assess the forest's entire network, how these areas relate to and interact with one another;
3. Reflect some of the similar issues and resource problems shared by many of the LSR/MLSA's;
4. Establishes guidance and the process to fully analyze in LSR/MLSA's in site specific detail when specific management activities are proposed; and
5. Yields a more cost effective approach to preparing assessments for LSR/MLSA's.

This document includes the assessments for four LSR's and two MLSA's. In the fall of 1996, the Forest LSR Team will reconvene to complete assessments for the remaining 21 LSR/MLSA's on the forest.

## Document Orientation

Chapters I through VII provide a forest-wide foundation upon which the assessments for individual LSR/MLSA's are based. Each chapter from VIII through XII, contain the assessment analysis for each of the six LSR/MLSA's (one LSR and one MLSA are combined due to similarity in vegetation, resources and other issues). Additional individual chapters will be added as each LSR/MLSA assessment is completed. The content of these chapters are summarized here:

**Chapter I - Introduction** - encompasses the goals and objectives for this assessment document, the members of the LSR oversight and core assessment teams and support members, and an overview of the LSR/MLSA's on the Forest.

**Chapter II - Vegetative Landscape** - focuses on the vegetation found on the forest and, in general, within late successional forests. It includes a discussion of the Range of Natural Variability, an important factor in east-side forest management; a discussion about late successional forests, and habitat sustainability and a description of the forest groups used throughout this document..

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# I. Introduction

In 1994, the Northwest Forest Plan (NWFP) initiated a Regional "Late Successional" network to help maintain the viability of species associated with older forests. The objective of this assessment is to determine how well the portion of this network within the Wenatchee National Forest is functioning and if any management strategies are necessary to sustain the network or the individual LSR's. Since the network envisioned by the NWFP was designed to function in harmony with existing land allocations, all lands associated with the Wenatchee National Forest Land and Resource Management Plan are considered.

Assessments, such as this, are a continuous process, and in fact, this is the second iteration describing the Late Successional Reserve situation on the Wenatchee. In July of 1995, the Forest completed a document titled "Late Successional Reserve Standard and Guidelines for the Wenatchee National Forest in the Eastern Cascades and Yakima Provinces." This report was initiated in 1992, in response to the Interagency Scientific Committee Report completed in May 1990. The purpose of this assessment was to: 1) Summarize the existing spotted owl information on the Forest; 2) Describe the long-term desired condition of the owl habitat; 3) Make recommendations for management to achieve desired conditions; and, 4) Identify additional research needs. Although this document did not provide enough specific information to support projects within the individual LSR's, it did a good job of analyzing sustainability in light of inherent disturbance regimes and prioritizing LSR's in terms of risk to loss from catastrophic fire.

As required by the NWFP, this mid-level assessment provides information and ecological rationale for Forest Plan Amendments, site-specific projects, and restoration and monitoring needs for management of Late-Successional Reserves (LSR's) and Managed Late-Successional Areas (MLSA's). It dovetails with current ecosystem analyses being completed at the watershed scale. The scale of this analysis, (714,358 acres of LSR's and MLSA's over a 2,500,000 acre area, is larger than the scale for watershed (ecosystem) analysis (50,000 to 200,000 acres). These multi-scaled, mid-level analyses are iterative. The following completed watershed analyses have more specific information about their respective watersheds: Chelan Basin, 25-mile/First Creek, Entiat, Mad, Ty-Chi, Kahler Creek, Tumwater, Icicle, Peshastin, Mission, Table Mountain, Box Canyon Creek, Taneum/Manastash, Little Naches, and Mainstem Naches.

**Table 1, Late Successional Reserves by Watershed**

LSR/MLSA	Watershed
Sawtooth	Chelan Basin
Lucerne	Chelan Basin
Shady Pass	Chelan Basin, Entiat
Slide Peak	Columbia River Minor Tributaries
Chiwawa	Mad River, Chiwawa, Wenatchee River
DM-1 Twin Lakes	Chiwawa
Little Wenatchee	White/Little Wenatchee, Nason Creek
DM-2 Natapoc	Wenatchee River
Deadhorse	Wenatchee River
DM-5 Eagle	Wenatchee River
DM-3 Tumwater	Wenatchee River
Icicle	Icicle
Boundary Butte	Peshastin
DM-6 Camas	Peshastin
Sand Creek	Mission
Swauk	Swauk(Table Mt.) Peshastin, Teanaway

**Table 2 - Oversight Team**

<b>Name</b>	<b>Title/Position</b>
Jim Pena	District Ranger - Naches
Catherine Stephenson	District Ranger - Cle Elum
Becki Heath	District Ranger - Leavenworth
Bob Sheehan	District Ranger - Lake Wenatchee
Karin Whitehall	District Ranger - Entiat
Al Murphy	District Ranger - Chelan
Glenn Hoffman	Group Leader Planning and Environment
Elton Thomas	Group Leader Resources
Vladimir Steblina	LSR Program Manager
Jodi Bush	U.S. Fish and Wildlife Service Biologist

**Table 3 - Core Team**

<b>Name</b>	<b>Title/Position</b>
Dave Tharp	Silviculturist
Heather Murphy	Wildlife Biologist
Bill Gaines	Wildlife Biologist
Richy Harrod	Botanist/Ecologist
Ann Camp	Research Forest Ecologist/Fire Ecologist
Michelle Davis	Geographic Information Systems
Ron Marvin	Writer/Editor & Co-Team Leader
Jim Furlong	Team Leader

**Table 4 - Support Team**

<b>Name</b>	<b>Title/Position</b>
Jodi Engle	Plant Ecologist
Karen Lindhorst	Fisheries Biologist
Bruce Keleman	Fire Planner
Jim Hadfield	Forest Pathologist
Jackie Haskins	Fish Biologist/Database Support
Pierre Dawson	Fish Biologist/Database Support
Jim Trowbridge	Silviculturist
Ruth Ann Miller	Planner
Colin Leingang	Wildlife Biologist

Table 5 LSR/MLSA Acreage and Habitat Overview

LSR/MLSA	ID Number	Size	Late Successional Habitat		Suitable Spotted Owl Habitat (N/R/F) <sup>1</sup>		Potential Suitable Spotted Owl Habitat (N/R/F) <sup>2</sup>	
			Acres	Pct.	Acres	Pct.	Acres	Pct.
Boundary Butte <sup>3</sup>	RW 131	8,743						
Bumping	RW 1126	14,989	9,314	62%	9,238	62%	13,126	88%
Chiwawa	RW 135	107,044	60,975	57%	49,489	46%	81,567	76%
Deadhorse	RW 133	18,319	9,843	54%	6,692	37%	11,044	60%
Icicle	RW 132	14,289	8,797	62%	7,861	55%	10,680	75%
Little Wenatchee	RW 134	52,524	29,632	56%	29,534	56%	45,470	87%
Lucerne	RW 138	8,643	5,236	61%	3,454	40%	5,485	63%
Manastash Ridge	RW 125	104,661	73,232	70%	68,147	65%	92,577	88%
Rattlesnake	RW 128	10,484	6,284	60%	5,632	54%	7,082	68%
Sawtooth	RW 139	15,246	3,543	23%	1,963	13%	3,607	24%
Shady Pass	RW 136	76,502	49,864	65%	42,224	55%	51,642	68%
Slide Peak	RW 137	1,658	341	21%	258	16%	341	21%
Swauk	RW 129	107,962	68,344	63%	45,675	42%	73,792	68%
Teanaway	RW 130	34,043	18,832	55%	16,352	48%	22,931	67%
Tieton	RW 153	39,998	26,876	67%	25,587	64%	32,747	82%
Upper Nile	RW 127	9,191	6,302	69%	6,136	67%	7,354	80%
Camas	DM-6	1,545	932	60%	541	35%	932	60%
Crow	DM-14	12,479	10,135	81%	9,950	80%	11,198	90%
Eagle	DM-5	5,267	3,194	61%	2,363	45%	3,250	62%
Haystack	DM-10	24,644	16,186	66%	9,998	41%	17,665	72%
Lost Lake	DM-12	6,946	4,890	70%	3,588	52%	5,112	74%
Milk Creek	DM-9	15,711	9,859	63%	9,133	58%	12,383	79%

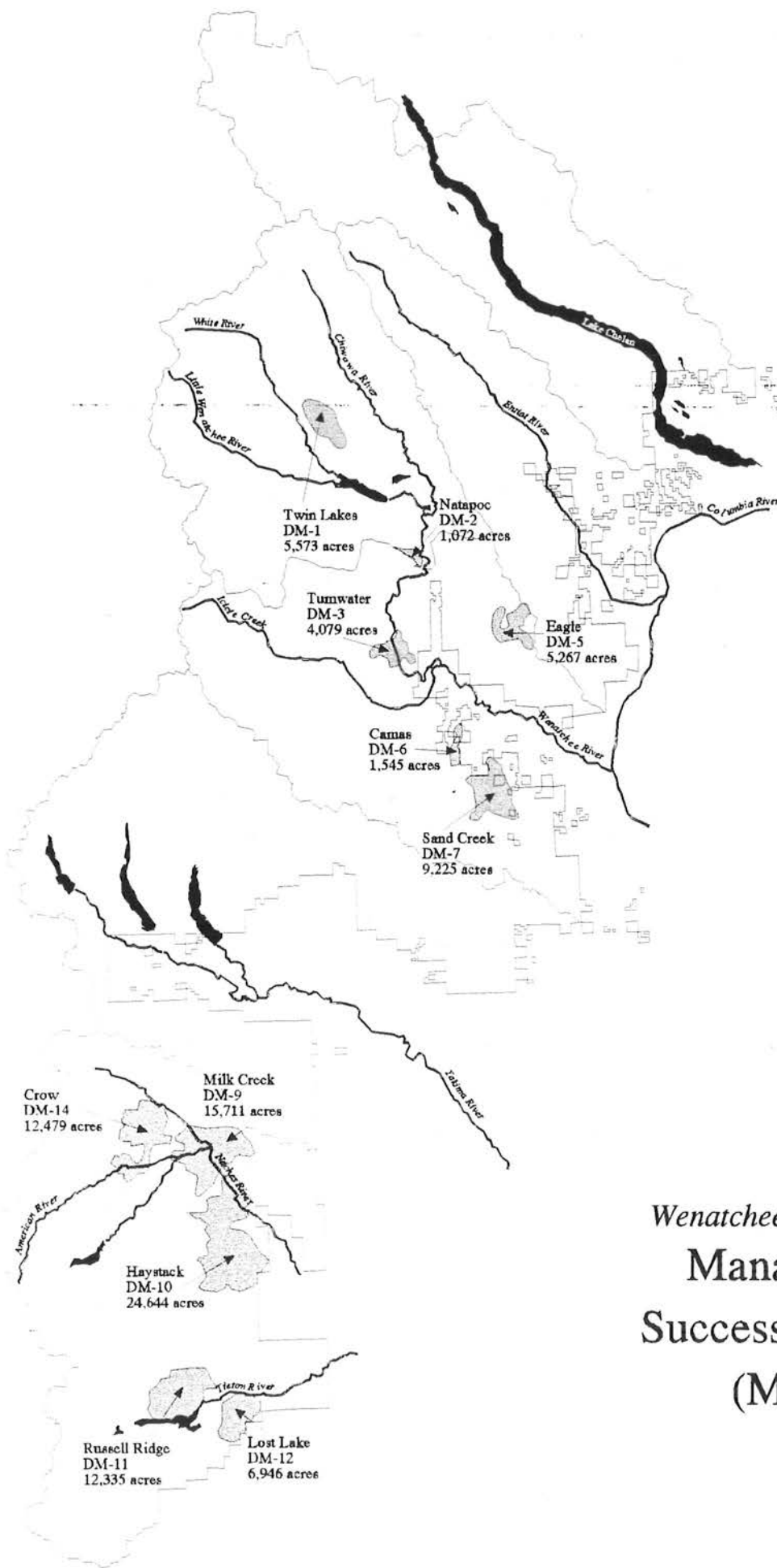
<sup>1</sup> Existing Suitable Spotted Owl Habitat includes forest structure that provides nesting, roosting and/or foraging habitat. Forest groups included are: Dry, Mesic, Moist, Subalpine, and Wet. Canopy closure is a minimum of 40%, forest structure is a minimum of medium sized trees with remnant old growth trees in overstory. These figures were modeled using the vegetation layer and from satellite imagery.

<sup>2</sup> Existing spotted owl dispersal habitat includes forest structure that provides habitat for dispersing spotted owls, this habitat is used when little nesting/roosting/foraging habitat is available. It includes all forest groups with 40% crown closure or greater and young stands of pole sized to medium sized, usually single story stands. These figures were modeled using the vegetation layer.

<sup>3</sup> Acreage calculations were not available for Boundary Butte LSR

<b>Watershed</b>	<b>Total Acres</b>	<b>Late-Successional Acres</b>	<b>Forested Acres</b>	<b>Percent Late-Successional of Total Forested Acres</b>
Peshastin	62,452	25,589	45,073	57%
Mission	36,577	16,044	29,236	55%
Yakima	78,477	27,730	59,292	47%
Teaaway	64,205	27,692	48,244	57%
Swauk-Naneum	71,155	35,183	61,923	57%
Taneum-Manastash	37,716	20,039	33,299	60%
Little Naches	83,883	47,683	77,555	61%
Naches	66,099	27,934	55,988	50%
Wenas	8,011	2,617	4,870	54%
Bumping	73,305	42,586	66,979	64%
American	50,662	24,204	45,001	54%
Rattlesnake	76,261	38,969	63,088	62%
Lower Tieton-Cowiche	47,980	23,330	36,378	64%
Upper Tieton	113,987	53,191	89,266	60%
Columbia	35,558	7,384	16,415	45%
<b>Total</b>	<b>2,211,450</b>	<b>843,377</b>	<b>1,625,480</b>	<b>52%</b>

None of the watersheds on the forest contain less than 15% late-successional habitat. LSR's and MLSA's tend to have a higher percent of late -successional habitat acreage than watersheds. Analysis shows that overall 67 percent of the LSR acres are late-successional (ranging from 24% to 82%) and that 68% of the MLSA acres are late-successional (ranging from 61% to 81%).



*Wenatchee National Forest*  
**Managed Late  
Successional Areas  
(MSLAs)**

## **II. Vegetative Landscape**

This portion of the document attempts to describe the variety and variability of vegetative components within Late-Successional Reserves (LSR) and Managed Late-Successional Areas (MLSA) on the Wenatchee National Forest. The information provided below should not be considered a final product, but rather a stepping stone in a long progression of measuring and describing important processes that influence ecosystem composition, structure, and function across the east slope of the Cascades. We recognize that vegetation is not static and, therefore, this document shall serve as a baseline for similar future analyses.

This portion of the document also attempts to describe "historic" vegetation within LSR's and MLSA's prior to Euro-American influence. This description will be used for comparative purposes with the existing vegetation condition. Each LSR and MLSA has been stratified by potential vegetation, but an emphasis is placed on community structures and compositions that result from disturbance, especially fire. Plant communities with similar fire regimes and resultant landscape vegetation patterns have been consolidated into "groups". Historic vegetation patterns were determined by a combination of "clues" from existing vegetation, historical reports, and environmental attributes.

In general, the goal of this analysis is to describe the current condition of vegetation and compare it to our best estimate of pre-settlement vegetation. Such a comparison will guide the development of management strategies based on achieving ecosystem sustainability. It is historic landscape conditions which is the goal, but not necessarily the "desire". Social needs and desires will ultimately temper vegetation management direction, but our analysis will allow for understanding the "trade-offs". This entire premise is founded in the concept of managing within the range of "natural" variability.

### **A. Range of Natural Variability**

The range of natural variability (RNV) refers to the composition, structure, and dynamics of ecosystems prior to the influence of Euro-American settlers (Swanson et al. 1994). This assessment used the concept of RNV to develop various management strategies. A relatively brief discussion is provided below which describes more detail about the use of the RNV in forest management. However, the reader is encouraged to read Swanson et al. (1994) and Morgan et al. (1994), since the following is based on those two publications.

The RNV has been used synonymously with "historic", "pristine", "prehistoric" and others. Regardless of the label, the concept is to provide a description of fluctuations over time within ecosystems prior to Euro-American settlement. Such variations include a diverse array of characteristics such as tree density, population sizes of organisms, water temperature, sediment delivery and so on. It can be applied at multiple spatial scales from the site to biogeographic region, and at multiple temporal scales from decades or centuries for landform erosion to millennia for geologic processes. The important point is that descriptions of natural variability need to be site specific; most appropriately at the watershed (20,000 to 100,000 acres) level and at temporal scales of centuries.

Disturbances were an integral part of historic landscapes. Native species have adapted to and, in part, evolved with disturbance events during the past 10,000 years. It follows that the potential for survival of native species and, consequently, communities they comprise is reduced if their environment is pushed outside the range of its natural variability. This rationale is an important premise of ecosystem management which strives to provide a baseline for comparison with current ecosystem conditions (Bourgeron and Jensen 1994). The goal is not to return managed landscapes into wilderness areas or return them to any single pre-existing condition, but the intent is to meet certain

The wet forest group on the Wenatchee National Forests are characterized by directional succession with infrequent disturbance. The periodicity of disturbances are likely shorter than in the above example, but late-successional forests have similar structure and function.

A more common type of succession is cyclic (Barbour et al. 1987), in which a particular community is perpetuated by the recurrence of some event. An example of this type of succession was present in the pre-settlement landscape on the east slopes of the Cascades and in other places throughout the western states. The dry forest group as presented here, serves as an example of a plant community perpetuated by cyclic succession. Lightning and indigenous people caused frequent fires on the historic landscape. These frequent (every 5-20 years) fires maintained forest structures on many sites at the lower and mid-elevations that were open and park-like at the landscape scale and dominated by ponderosa pine (Agee 1994, 1993, ROD B-4). Even on sites that are today dominated by dense Douglas-fir or grand fir (climatic or edaphic (soil-related climax)), fire tended to favor the open structure and ponderosa pine. These open, park-like communities were maintained in a late-successional stage (ROD B-2), or fire climax (Komarek 1968), largely because ponderosa pine are fire tolerant (Mutch 1970).

At the stand level in the dry forest group, patch sizes tended to be small (<1 acre) (Agee 1994) and fire intensity and severity was low. As a result, landscape vegetation patterns were "stable" and succession was cyclic in nature (Agee 1994). The exception to this landscape pattern were the mesic sites (mesic forests used here) on northerly aspects and riparian areas which tended to have longer fire free intervals and the opportunity for more stand differentiation (fire intolerant species understories) (Camp 1995, Sloan unpubl. rep.).

### C. Current and Historic Vegetative Landscape Conditions

This section describes, in general, the current condition of vegetation groups within all LSR's and MLSA's on the Wenatchee National Forest. A description of historic conditions for each vegetation group is also provided. Current vegetation has been stratified by potential vegetation (e.g., forest series), but emphasis is placed on community structure and composition that resulted from the historical fire disturbance regime in this area. Plant communities with similar fire regimes and resultant landscape vegetative patterns have been consolidated into vegetation groups (Appendix 3, "LSR/MLSA Vegetation Photo Mapping Key") as described below.

Data was primarily derived by delineating vegetation stands or polygons on 1992 color aerial photographs. Stand identification was facilitated by local knowledge, the North Cascades Grizzly Bear Vegetation map (satellite imagery) north of Interstate 90 (Gaines et al. 1994), and field survey plot data. Where this data did not exist, a GIS vegetation model was used (Appendix 2). This model provide vegetation maps which are useful at the landscape scale, but would not be appropriate for use at the project level. For example, the model could not accurately distinguish mesic embedded within the dry forest vegetation group. An important point is that vegetation mapping, whether it was derived by modeling or by aerial photo interpretation, places hard lines between vegetation structural stages or types which in reality are often broad ecotones. Therefore, it is important that modeled vegetation maps only be used as a starting point for project analysis and that site specific information will need to be collected during project planning.

Vegetation pattern and distribution on the landscape is determined by local climate, soils, topography and perturbations. Many plants are adapted to periodic disturbances, particularly fire which is an important disturbance in the East Cascades of Washington State. Other disturbance factors include past timber harvesting, grazing and browsing by ungulates, chronic insects and diseases, windthrow, flooding, weather events (drought, freezing, etc.) and erosion (mass wasting).

A general description of each vegetation group (refer to glossary) will be followed by its estimated historic condition. All scientific binomials follow the *Flora of the Pacific Northwest* (1973).

Riparian areas, northerly aspects, and other mesic sites were the exception to the open, park-like landscape. We have termed them **mesic sites** in this document, and the largest and most obvious of these have been mapped when aerial photo interpretation has been used. Growing conditions are better on mesic sites allowing Douglas-fir and grand fir to become established in the understory faster during the fire free interval (Agee 1994, Agee 1991). A variety of stand structures and species compositions would have been present depending on the frequency and severity of fire.

Historically, landscape patterns and composition within the dry forest vegetation group are estimated as displayed in Table 7.

**Table 7 - Historic Landscape Patterns and Composition within the Dry Forest Group**

Structure	Abundance
Open, park-like (fire climax) with herbaceous understory.	80-90%+
Mixture of small mesic Douglas-fir inclusions with dense cover or stand replacement openings. <ul style="list-style-type: none"> <li>• Dry vegetation group sites with understories over age 20 (usually longer than normal fire cycle).</li> <li>• Riparian, mesic Douglas-fir site or moist grand fir inclusions with dense cover or stand replacement openings.</li> <li>• Dry vegetation group sites at upper elevation margins with stand structures similar to moist grand fir.</li> </ul>	10-20%

## 2. Mesic Forest Sites (Embedded within the Dry Forest Group)

### a) General Description of Vegetation Group

Mesic sites have been defined as those forest stands which occur on steep northerly aspects where moisture is less limiting to site capacity as compared to the surrounding dry forest landscape. Plant associations that occupy these sites include: *P. menziesii/Symphoricarpos albus*, *P. menziesii/S. albus-Calamagrostis rubescens*, and occasionally some grand fir plant associations such as *A. grandis/Berberis nervosa*, *A. grandis/Arnica cordifolia*, or *A. grandis/S. albus/C. rubescens*.

Mesic sites were not identified in every LSR or MLSA because of the differences in the approach to mapping vegetation throughout the Wenatchee National Forest (see above). However, it can generally be stated that mesic sites comprise 10 to 15 percent of the Dry Forest Group.

For consistency, all northerly moist aspects forest-wide were considered mesic sites. However, on the Naches and the southern portion of the Cle Elum Ranger Districts, mapped mesic sites are more appropriately identified as moist grand fir plant associations. This is largely because district boundaries are located further west and occur at higher elevations as compared to districts further north. On the northern portion of the Wenatchee National Forest, mesic sites are those sites in the dry forest group (primarily ponderosa pine and dry Douglas-fir plant associations) that have a higher potential, as compared to the surrounding vegetation, to sustain higher tree densities in a fire frequent landscape (see Historic Conditions below).

### b) Current Condition

A large proportion (72 percent) of mesic sites consists of layered stands dominated by Douglas-fir (Appendix 4 and 5). In many cases, ponderosa pine is represented by a widely scattered overstory since the younger, small diameter trees are being, or already have been, out-competed.

burned with similar intensity and severity as compared to historic fires (see Historic Section below). It is difficult to compare the small acreages in the LSR to historic landscape conditions; however, 54% of this forest group burned with high severity in the 1994 fires, which is slightly above that estimated for areas with moderate severity regimes (see Agee 1993).

## (2) Historic Conditions

Unlike the drier portions of the grand fir series, this vegetation group is transitional between the frequent, low intensity fire regime of the dry forests and the infrequent, high intensity regime of the subalpine fir series. The more cool and moist grand fir associations were influenced by a moderate severity fire regime. The moderate severity fire regime has a complex interaction of low, moderate, and high severity fire. Such variable fire intensities and severity created a complex mosaic pattern in these moist grand fir associations (Agee 1994). Under severe fire weather, extremely large areas could be intensely burned. Moderate to low intensity fires, which occurred more often, broke the large patches created by extreme fire events into smaller patches. These events combined to form complex landscape patterns that were highly variable in both time and space.

Low intensity fires may have reduced tree basal areas up to 20%, tending not to initiate understory development (Agee 1994). Moderate intensity fires may have reduced tree basal area from 20-70%, initiating understory development of both seral and shade tolerant species (depending on opening size). Intense stand replacement fires may have reduced tree basal areas 70-100%, tending to create openings where shade intolerant species could regenerate (Agee 1994).

Many moist grand fir sites are located in close proximity to dry vegetation group stand types. Fire frequency on these sites must have been influenced by these neighboring stand structures and fire regimes. The moderate fire regime seldom produce climax grand fir stands because successional development of these stands would require a fire free period in excess of 200 years. Very moist and protected riparian areas may have been the exception. It is estimated that approximately 10% of this vegetation group existed as late-successional disturbance refugia (Camp 1995).

## b) General Description of Mesic Western Hemlock Forest Group

This forest group is primarily located on the south end of the Wenatchee National Forest. Plant associations within this group include *Tsuga heterophylla/Berberis nervosa* and *T. heterophylla/Achlys triphylla* being the most extensive. Other minor plant associations in this group include *T. heterophylla/Arctostaphylos nevadensis* and *T. heterophylla/Asarum caudatum*. These association occur on northerly aspect from 3000 feet to 5000 feet in elevations and is replaced by the moist grand fir forest group on southerly aspects.

## (1) Current and Historical Conditions

Four percent (28,474 acres) of the LSR's and MLSA's on Wenatchee National Forest consists of this forest group (Appendix 4 and 5). This forest group occurs primarily on the southern portion of the forest. The current and historical descriptions for this group are essentially the same as that for the moist grand fir group (see above).

# 4. Subalpine Fir Group (True subalpine Fir Series)

## a) General Description of Vegetation Series

The subalpine fir (*Abies lasiocarpa*) series extends from mid-elevation, generally above 4,900 feet, to upper timberline, and is one of the coolest and most moist of the forested zones. Cool summers, cold winters, and development of deep winter snow packs are more important factors than total precipitation in differentiating this vegetation group from lower forested zones (Franklin and Dyrness 1973).

The distribution of the plant series within this vegetation group can be generalized. In the upper third of watersheds, the transition in dominant vegetation from valley bottom to ridge top consists of codominant western hemlock and western red cedar (*Thuja plicata*), silver fir and western hemlock, silver fir and mountain hemlock, and mountain hemlock and some subalpine fir, respectively. There tends to be considerable overlap in plant associations along elevational gradients.

### b) Current Condition

Twenty-three percent (161, 564 acres) of LSR's and MLSA's is comprised of this forest group (Appendix 4 and 5). The current condition of the forest group is highly variable. In some locations, little timber harvest has occurred while in others logging has been extensive. For example, less than 10% of the Bumping, Little Wenatchee, Tieton, and Upper Nile LSR's have been harvest. Similar to the subalpine fir series, not enough time has past for fire exclusion to have a significant impact on the successional character of this forest group which historically experiences long fire-free intervals.

### c) Historic Condition

#### (1) Western Hemlock and Silver Fir Series

Fire return intervals are not well-known for the western hemlock, western red cedar (Agee 1994), and Pacific silver fir series. However, fire return intervals are thought to have been long, 100 to 500 years (Agee 1993, Agee 1994, Hessburg et al. 1994, Williams and Smith 1991), and consisted mostly of stand replacement events generally 4000 to 8000 ac (Agee 1993, Agee 1994). High severity fires tended to kill all the trees on the site, while low to moderate severity fires, occurring at a variety of intervals, favored a mix of tree species. For example, Hessburg et al. (1994) state that severe fires within the western hemlock series at intervals less than 200 years favored lodgepole pine when lodgepole was present in the original stand, while intervals longer than 200 years tended to favor western larch and western white pine (*P. monticola*). Fires of moderate intensity promoted establishment of western larch, Douglas-fir and western white pine (Williams and Smith 1991).

#### (2) Mountain Hemlock Series

As previously mentioned, the mountain hemlock series is more closely associated with the subalpine fir series. Fire return intervals tended to be somewhere between 100 to 200 years (Agee 1994). However, little is known of fire effects in the eastside mountain hemlock series because of their limited distribution. Agee (1994) notes that stand-replacing events appear to be variable in size tending towards a frequency distribution represented by a negative exponential curve (few large fires, many small fires). On drier sites, whitebark pine would have been present as an early seral dominant. Early successional stages would be maintained by periodic lightning caused fires. In the more moist sites, fires were less common and late successional forests dominated.

Forest structures and patterns were complex and are difficult to describe. Old photographs and records of past fires were used to age younger stands within the wet forest group that were visible on 1992 aerial photographs. The probable past abundance of those structures on the landscape are presented in Table 9.

Table 9, Historic Landscape Structure within the Wet Forest Group

Approx. Structure	Age	If 200 Year Stand Replacement Interval	If 400 Year Stand Replacement Interval	Range
Created opening, sapling, or small poles	0-65	$65/200 = 32.5\%$	$65/400 = 16\%$	16-32.5%
Single layered pole stands	66-130	$65/200 = 32.5\%$	$65/400 = 16\%$	16-32.5%

### a) Upland Meadows

Upland meadows were mapped at high elevations (above 5,000 feet) interspersed with subalpine forest communities. Little ecology plot data has been collected in this vegetation type. Upland meadows generally were identified as treeless (or with very few trees), fine textured, brownish to light green, and occurring on slopes or rounded ridges. Standing water was not apparent. There are a variety of communities occurring in areas classified as upland meadows identified by del Moral (1979a; 1979b).

Many upland meadows were grazed by sheep from 1870 to the 1950's, some to present day. The effects that sheep had on upland meadows is unknown, but observation of current-day grazing of lower montane forests may provide some clues. We have observed that sheep bedding grounds easily become void of vegetation if large bands (800+) return to the same spot more than two nights. If the same kind of damage regularly occurred in high elevation upland meadows, the effects may be seen even after decades of "rest". Alpine and subalpine plants are relatively slow growing, and occupation of disturbed sites may take a considerable amount of time. On the other hand, many alpine and subalpine plants are quite hardy tolerating high winds, blowing snow and sand, and high light intensities. If grazing was light and bands were moved from bedding ground to bedding ground frequently, it may be difficult to determine any impacts. For lack of better information, we provide no conclusions.

### b) Wet Meadows

Wet meadows were mapped in various localities from mid-montane to subalpine habitats. Again, little ecology plot data exists for interpretation of species composition of wet meadows. Wet meadows were mapped from aerial photos as having a green to dark green appearance, located in wide riparian areas, in cirque basins, or near subalpine lakes. Standing water was often apparent.

Wet meadows that were identified in the highest elevations likely correspond to del Moral's (1979a; 1979b) *Carex nigricans*-*Lupinus polyphyllus*-*Vaccinium cascadenis* community and more generally Douglas and Bliss's (1977) *Carex nigricans* community. *Carex nigricans* is an indicator of hydrophytic conditions and its presence in the areas we mapped as wet meadow is likely. Some seasonal upland bogs exist near Table Mountain.

Wet meadows identified along wide, high elevation riparian areas or in cirque basins probably correspond to that described by Harrod and Taylor (in press) for the headwaters of Noisy Creek near Mount Watson. Such meadows are dominated by *Carex lenticularis* and *Agrostis thurberiana*. Contiguously grouped individuals of *Salix barclayi* and *S. commutata* may be present. A number of other species known to occur in high elevation wet meadows such as *Potentilla flabellifolia*, *Leptarrhena pyrolifolia*, *Pedicularis groenlandica*, *Tofieldia glutinosa*, and *Hypericum anagalloides*.

### c) Grasslands/Shrublands

Grasslands/shrublands are found below lower timberline and/or are typically small inclusions within the dry forest vegetation group, usually related to topographic changes and located mostly in deep canyons on south and west aspects. They may also occur at higher elevations adjacent to subalpine fir and whitebark pine communities. They are part of the steppe region described by Daubenmire (1988). Grassland/shrubland sites are not capable of supporting a forested community. A few conifer trees may exist in isolated micro-sites sufficient to support limited forest community development. Canopy closure is generally less than 10% where trees exist. The climax shrub communities of the eastern Cascades provide diversity to the landscape as part of a vegetative mosaic (Johnson et al. 1994).

Climax shrublands are communities where a shrub species are the dominant plant form, whereas grasslands are dominated by grass species. On the Wenatchee, bitterbrush (*Purshia tridentata*), sagebrush (*Artemisia tridentata*), and buckbrush (*Ceanothus velutinus*) are the most widespread shrub

Plant associations of the moist grand fir group, with moderate severity fire regimes, are no longer experiencing low severity fires because of fire exclusion (Agee 1994). The complex mosaic of stand types created and maintained prior to fire exclusion favored seral, more fire tolerant species over dominant, shade-tolerant species (Agee 1994). As a result, high-severity fires are now quite likely in moist grand fir associations. The 1994 Rat Creek Fire provides an excellent example of the potential for high intensity, high severity fire in this vegetation group.

### III. Disturbances, Forest Overview

#### A. Introduction

Disturbances are an intrinsic part of ecosystem development (Cooper 1913, Raup 1957, Oliver 1981, Pickett and White 1985). On the Wenatchee National Forest, ecosystems within Late Successional Reserves developed in concert with, and are subject to, a variety of natural, introduced, and altered disturbance regimes. A disturbance regime refers to an integration of disturbance attributes including type, frequency, intensity, duration, and extent (Pickett and White 1985). Natural disturbances on the Wenatchee NF include fire, insects, pathogens, windthrow, and weather. Introduced disturbances include livestock grazing, mining, timber harvesting, roading, insects (including the larch casebearer and the balsam woolly adelgid), and pathogens (especially white pine blister rust). Natural disturbance regimes have been altered by management activities, including fire exclusion, livestock grazing, and timber harvesting. Potential global climate change may further impact disturbance regimes.

Ecosystem and landscape composition and structure results from, and in turn, influences disturbance regimes at different spatial and temporal scales. Disturbances and successional trajectories interact, creating patterns of vegetation across landscapes (Bormann and Likens 1979, Pickett and White 1985, Oliver and Larson 1990, Lehmkuhl and others 1994). Landscape vegetation patterns can amplify (Turner and Bratton 1987, Franklin and Forman 1987) or impede (Knight 1987, Rykiel and others 1988) the spread of disturbances across landscapes. Disturbances create patterns at the stand level, as well. Individual trees killed by lightning, root decay pathogens, or insects provide snags whose attributes are a function of the mortality agent and the species killed. The act of lightning striking a resinous ponderosa pine produces a hard snag that may endure for decades; grand fir killed by root and stem decaying fungi will form a soft snag that may topple within a decade.

On the Wenatchee NF, patterns of vegetation and their associated disturbance regimes are strongly influenced by geomorphology, landforms, topography, physiography, and orographic precipitation gradients. Historically, this template acted as an environmental sieve or filter under which regional floral and faunal diversity developed. Altered vegetation patterns and their associated disturbance regimes create conditions beneficial to some species but put other species at risk. More importantly, altered disturbance regimes potentially destabilize ecosystems and landscapes, thus creating conditions that may promote unprecedented catastrophic disturbance events. In turn, they may seriously reduce ecosystem resiliency - the ability to return to prior levels of productivity. Loss of soil nutrients may take decades to replace; loss of the soil itself will take centuries.

Some of the most-altered vegetation patterns and disturbance regimes on the Wenatchee NF are within dry forest types: those in the ponderosa pine and Douglas-fir series, and in the warm, dry grand fir associations. Disturbance regime alterations are primarily a result of fire exclusion, and have been exacerbated by selectively harvesting large, old ponderosa pine and, more recently, large individuals of other tree species. Altered disturbance regimes in dry forests greatly affect the sustainability of adjacent, more mesic forest types. Changes to other forest types, especially those at higher elevations near the crest of the Cascades, are not as dramatic; however, fire exclusion and other management actions, coupled with native and introduced insect and pathogen dynamics have put these ecosystems and landscapes at greater risk to unprecedented catastrophic disturbances. A stand at risk to catastrophic fire and embedded in a fire-resistant landscape is at less risk to loss than a fire-resistant stand embedded in a matrix prone to stand-replacing fires.

Most of this chapter discusses differences between current and historical disturbance regimes in forest types found on the Wenatchee National Forest; however, non-forested lands within the Forest boundaries also have characteristic disturbance regimes, some of which have been altered by the exclusion of fires or by other activities. Fire exclusion is allowing trees to invade some upland meadows (Everett and Beebe, unpublished). Dry upland and seasonally wet meadows have

## 1. Historic Disturbance Regimes and Primary Disturbance Agents

Prior to Euro-American settlement, the primary disturbance within dry forest types on the Wenatchee NF was frequent, low intensity ground fires of natural and anthropogenic origin. Fire-return intervals within ponderosa pine, warm/dry Douglas-fir, and warm/dry grand fir series ranged from 7 to 33 years (Wischmofsky and Anderson 1983, Everett and Schellhaas, unpublished manuscript). Frequent fires kept fuel levels low, prevented the establishment and growth of thin-barked, shade-tolerant species, and perpetuated early seral species, particularly ponderosa pine. Frequent underburning resulted in open, park-like stands with one or two canopy layers and discontinuity between tree crowns and ground fuels. Scattered large, open grassy areas on thin soils were almost as distinctive as the park-like stands of ponderosa pine (Hessburg and others 1994).

Insects and pathogens played a role in these simplified forest ecosystems, contributing to the development of important wildlife habitat, nutrient cycling, and stand and landscape-level diversity. Historically, insects and pathogens within dry forest types operated at the individual tree or small patch level. Insects and pathogens acted in concert with fires to reduce stand density. Trees scorched, but not immediately killed, by low intensity ground fires were susceptible to attack by pine engraver beetles and Douglas-fir beetles. Armillaria root disease killed small numbers of trees weakened by overcrowding, drought, or fire. Fire scars provided infection courts for decay organisms which in turn created conditions favorable for macroinvertebrate wood decomposers, especially carpenter ants. Freshly-killed trees were soon invaded by wood borers that provided forage for woodpeckers and created tunnels that facilitated the entry of other wood-decomposing agents. Parasitic dwarf mistletoes were kept in check by the fire regime. Heavily-infected trees were likely to torch as ground fires climbed into the crowns of infected trees on resinous stems, dead branches, and brooms (Weaver 1974).

Western pine beetle was the most important disturbance agent, besides fire, in historical dry forest types. Large, old ponderosa pine were the preferred host of the western pine beetle (Keen 1943, Wickman and Eaton 1962). Beetles killed lightning-struck trees, trees infected with root diseases, and trees unable to resist attack because of age or competition-induced stress. During periodic droughts such as occurred during the 1920s and 1930s, forests dominated by large ponderosa pine sustained outbreaks of this insect (Miller and Keen 1960). Ponderosa pine snags provided nesting habitat for cavity excavators and secondary cavity users. Birds and other insectivores exploited the insects within beetle-killed trees. When they fell, these snags became logs, providing habitat to other vertebrates and decomposers. Log longevity in historic pine forests is not known, but frequent fires probably consumed many, if not most, within several decades.

Under historic fire regimes, defoliators, root diseases and dwarf mistletoes played minor roles in the dry forest types on the Wenatchee NF, especially when considered at landscape scales (Hessburg and others 1994). The importance of these disturbance agents increased in more mesic areas within the dry forest group where longer fire-return intervals allowed late-successional host species to establish and grow.

## 2. Current Disturbance Regimes and Primary Disturbance Agents

During the past century, pre-settlement disturbance regimes were radically altered in the dry forest types on the Wenatchee NF. Grazing, first by cattle, and then sheep, began as early as the 1840s and continued into the present century (Holstine, 1994 or 5). Grazing substantially reduced fine fuel levels, and probably was more important than actual suppression activities in excluding fires from dry forest ecosystems early in this century. Extirpation of native cultures and the concomitant elimination of Native American ignitions as well as routine suppression of natural and human-caused fires allowed forest development to proceed further along successional trajectories.

areas, putting these sensitive ecosystems at increased risk to future fires, and reducing the presence of large, live Douglas-fir, an important habitat component of riparian ecosystems.

Mortality associated with the fir engraver has increased tremendously since Euro-American settlement. The host, grand fir, has encroached outward from historic fire refugia and, along with Douglas-fir, dominates many stands in the dry forest type. Fir engraver mortality is associated with trees weakened by competition for limited resources and those infected with root diseases. Dense stands on dry sites provide ideal conditions for fir engraver outbreaks to originate. Stand density increases competition for resources, predisposing trees to attack. Dense stands promote the spread of root diseases through species-specific, root-to-root contact. Increases in host species abundance, coupled with conditions that promote fir engraver attacks (increased incidence of root diseases, persistent drought, and severe defoliation) have increased the role played by the fir engraver beetle (Hessburg and others 1994, Wright and others 1984).

Much is known about the ecology and population dynamics of defoliating insects (Wickman 1978, Brookes and others 1978, 1985, 1987, Mason 1977, 1981). The role of defoliating insects was historically limited by the lack of host species within dry forest types on the Wenatchee National Forest. Although the climate within dry forest types on the Wenatchee National Forest is favorable for western spruce budworm reproduction, outbreaks of this insect were historically restricted to a few scattered, susceptible stands. When food supplies within a stand were depleted, outbreaks collapsed. Currently, horizontal (between adjacent stands) and vertical (within a stand) contiguity of host species allows outbreaks to cycle back and forth among stands (Hessburg and others 1994). Chronic defoliation will continue where susceptible stands are contiguous. Damage severity will increase with increasing stand age. There has only been one documented outbreak of Douglas-fir tussock moth on the Wenatchee NF; however, present structure and composition within dry forests predispose them to future damage by this defoliator. Mortality within stands attacked by the tussock moth is frequently high; trees not killed outright are at risk to subsequent, usually lethal, attacks from bark beetles.

Root diseases are much more prevalent today than historically (Hagle and Goheen 1988, McDonald and others 1987, McDonald 1990). Dry, grand fir climax forests which were selectively harvested have high levels of S-group annosum root disease and Indian paint fungus stem decay. Spores of the annosum root disease fungi, infect cut stumps and residual trees wounded during harvest; decay spreads by root-to-root contact (Filip and Schmitt, 1979. Hadfield and others 1986). Indian paint fungus invades suppressed trees on small branches that die from lack of light. Trees encapsulate the infection, which does not spread until the tree matures and is wounded near the original point of infection. Armillaria root disease and P-group annosum root disease take a greater toll on residual large, old ponderosa pine than historically. Fire exclusion increased numbers of trees competing for soil moisture and nutrients, and dense stands promote disease spread by root-to-root contact. As large, old pine die, their value as wildlife habitat persists, but with forest understories dominated by shade-tolerant species, the presence on the landscape of large, ponderosa pine - living or dead - is rapidly declining.

Dwarf mistletoe infestations are also increasing in dry forests, contributing important avian habitat and elevating risk of crown fires within infected stands. Dwarf mistletoes are host-specific parasitic organisms; spread is favored by multi-canopy stands in which host trees are well-represented in each canopy layer. At least 43 percent of the Douglas-fir and 26 percent of the ponderosa pine are infected with dwarf mistletoes; 21 percent of stands containing true fir are likewise infected (Bolsinger 1978; Hessburg and Flanagan 1992). Infestations of larch mistletoe speed successional trajectories toward stand dominance by later-successional species. Dwarf mistletoe infestations result in elevated amounts of fine fuels and heat-trapping brooms that carry fires into crowns of infected trees. Mistletoe infestations are a vector for propagating high intensity, stand-replacing fires across landscapes.

### **C. Mesic Forest Sites (Embedded within the Dry Forest)**

## **2. Current Disturbance Regimes and Primary Disturbance Agents**

Disturbance types within mesic forests have not changed appreciably since settlement, fire being the noted exception. Fire exclusion in surrounding dry forests has virtually eliminated fire's sanitizing role in removing dense stands infested with insects or pathogens. Fire exclusion also precludes fire's role in periodically thinning the understories of mesic forests, especially during recurring periods of drought when moisture levels within mesic forests are depleted (Camp 1995, Hessburg and others 1994).

What has changed during the past century is that mesic forest structure and composition has expanded outward and been homogenized within the dry forest type. Fire exclusion allowed adjacent dry forests to develop structures and compositions similar to those within mesic stands. The spread of mesic forest structure and composition to sites formerly dominated by park-like stands of ponderosa pine has allowed mesic forest disturbance regimes to invade areas to which they were previously excluded. The extent of insect and pathogen infestations and outbreaks, no longer confined within the boundaries of mesic stands, has increased substantially over historic levels.

Insects and pathogens whose populations have increased and expanded into surrounding dry forests because of landscape homogenization include western spruce budworm, Douglas-fir beetle, fir engraver, Douglas-fir dwarf mistletoe, and Armillaria and annosus root diseases. Mortality from Douglas-fir and fir engraver beetles has increased and spread into adjacent dry forests where historical composition and structure precluded these insects. Douglas-fir dwarf mistletoe proliferation is exacerbated by exposing the mistletoe plant to light, such as through a partial harvest. Currently, the incidence of root diseases is increasing in mesic forest stands and spreading into adjacent dry forest types. Laminated root rot now occurs on sites that historically did not support this disease. Armillaria and annosus root diseases are more prevalent and more damaging than historically, especially where partial harvesting left large stumps that serve as infection courts (Hadfield and Flanagan 1995).

## **D. Moist Forest Group**

### **1. Historic Disturbance Regimes and Primary Disturbance Agents**

Historic disturbance regimes of forests within the moist grand fir associations were a complex interaction among fire, insects, pathogens, and weather. On the Leavenworth Ranger District, Wishnofske and Anderson (1983) reported fire-return intervals of 33 to over 100 years. Fire history reconstructions from 12 spotted owl nest stands in the ABGR/ACTR, ABGR/ARCO, and ABGR/ACCI plant associations on the Wenatchee NF show fire-return intervals between 11 and 25 years, with an average of 16 years (Schellhaas, unpublished data). Minimum and maximum fire-free intervals within these 12 stands were four and 48 years respectively. The short fire-free intervals found by Schellhaas are probably because these stands were relatively small and surrounded by dry forests that burned frequently. Fires burning into moist grand fir stands from adjacent dry forests blurred differences in forest structure and composition at the moist/dry interface. Unless weather conditions and fuel loads were conducive to their further propagation, ground fires originating outside moist grand fir stands were eventually extinguished by the higher humidities and more mesic conditions within these stands. Longer fire-free intervals would presumably occur in the interior of larger patches of moist grand fir forests. Both small and larger patches within moist grand fir associations were probable sites for historic fire refugia - stands that burned less frequently than the surrounding matrix (Camp 1995).

Fire intensities in the moist grand fir associations range from low to high; fire effects on vegetation varied with respect to fire intensity. Low intensity, surface fires allowed ponderosa pine, western

to inflict heavy damage to western white pine. Mortality during the 1930s and 1940s was especially severe, and many western white pine were harvested during this period, in anticipation of their probable death from white pine blister rust. Salvage harvesting of dead and dying whitepine continued into the 1970's in parts of the Wenatchee National Forest, including the Manastash and Teanaway LSR's. Stands dominated by seral pine were pushed further along successional trajectories by the pathogen; snag and log recruitment rates were quickly elevated. Trees infected with blister rust die from the infection itself or from subsequent bark beetle attack. Infected pines can maintain high populations of bark beetles, which may kill other pines not yet infected by the rust. Seedlings and saplings released by the death of the pine grew rapidly on productive moist grand fir sites, forming multi-layered stands with an abundance of large snags and logs.

Indian paint fungus causes heartwood decay in infected trees, but does not directly kill trees. Infected trees are, however, subject to breakage. Indian paint fungus has moved into grand fir forests from higher-elevation silver fir and mountain hemlock series forests where, because of longer fire-return intervals, it was historically more common. Excluding fire in moist grand fir stands has increased the infection frequency and the volume of wood decayed by the Indian paint fungus. Decay losses are commonly very high in stands where partial harvesting wounded suppressed, residual trees. Severe outbreaks of western spruce budworm in the 1970s topkilled many grand fir and activated tremendous Indian paint fungus infections.

Root diseases that spread through the root-to-root contact of susceptible hosts are increasing with increasing stand densities and greater proportions of host species. Additionally, partial harvesting creates stumps and wounds that are infection courts for root diseases. Annosum root diseases, once uncommon, are spreading rapidly. The spread of S-group annosum root disease has occurred because the harvest of large grand firs within a moist grand fir forest left stumps that were subsequently infected by windblown spores. (Hadfield and others 1986). Partial cutting of grand fir in previously uncut moist grand fir forests will create new disease centers (Gast and others 1991, Schmitt and others 1991).

Bark beetle populations are greater today than historically. Mortality inflicted by these insects contributes to an abundance of snags and logs in some moist grand fir stands. Fire exclusion has increased the incidence and severity of mountain pine beetle attacks. With age, lodgepole pine is increasingly susceptible to this insect. Historically, lodgepole pine stands at all developmental stages occurred across the landscape. Now, many stands are susceptible to beetles and fire control prevents their being recycled to earlier developmental stages where susceptibility is lessened. Engraver beetle and Douglas-fir beetle mortality is greater than historically, because these insects attack suppressed trees in dense stands, and trees that have been weakened by outbreaks of defoliators and pathogens (Hessburg and others 1994). Large Douglas-fir in riparian areas are particularly susceptible to Douglas-fir beetle, especially during protracted droughts or where mining or irrigation has reduced riparian soil moisture levels.

The scale of defoliator outbreaks has increased from stand to landscape, because host species are more connected within (vertical distribution) and among (horizontal distribution) stands. Outbreaks weaken trees, predisposing them to attack by other insects or pathogens. Defoliation often kills suppressed understory trees. Overstory trees may survive, but secondary attacks by other insects or pathogens on weakened trees are often lethal.

Elevated mortality from native and introduced pathogens and insects increases fuel loads within moist grand fir stands. These stands are spatially connected to drier forest types that also have excessively high fuel levels. Moderate and severe intensity fires originating in dry forests adjacent to moist grand fir forests will likely penetrate well into these stands. Fires will likely be stand-replacing, because species within these stands are very intolerant of fire, or have crowns connected to ground fuels through dwarf mistletoe infections or high snag levels from insect and pathogen activity within these stands.

This barrier effect is negated during extreme fire weather, and should not be relied upon, nor do avalanche tracks appear to be a significant barrier to the spread of fire on the Wenatchee NF (Bruce Kelleman, pers. comm.). Currently, dwarf mistletoe infestations are a major cause of mortality in western larch, greatly reducing its presence as a live tree, but creating tall, large snags. White pine blister rust and subsequent mountain pine beetle attacks on infected trees has reduced the presence of western white pine across the Wenatchee NF. Almost all mature trees show evidence of the disease. Fire suppression has reduced the extent of fires within the wet forest communities which, along with the introduction of white pine blister rust, is reducing the presence of seral species within wet forest types.

## **F. Subalpine Fir Forest Group**

### **1. Historic Disturbance Regimes and Primary Disturbance Agents**

Historic disturbance regimes varied within subalpine fir forests. Generally, fires in subalpine fir forest types were infrequent (over 100 years) and intense, resulting in complete stand-replacement on over 70 percent of the burned area (Agee 1990). Stand-replacing fires initially homogenized landscapes; over time, the activities of pathogens and insects provided fine-scale diversity and heterogeneity. At intervals of less than 200 years, stand-replacing fires in the subalpine fir series favored even-aged stands of lodgepole pine; return intervals greater than 200 years often reduced the presence of lodgepole pine and favored early dominance by Douglas-fir and western larch. Douglas-fir was favored on warmer, drier plant associations; western larch was less common north of the Entiat River (Williams and Smith 1991). Subalpine fir is very intolerant of fire; mortality was high even when fires did not crown; however, the low branches of subalpine fir and its associated canopy lichens often carried fires into the canopy (Huff 1988), which increased fire extent.

Once established, lodgepole pine tended to perpetuate itself. Mountain pine beetles attacked mature stands of lodgepole pine; mortality was high. Outbreaks of mountain pine beetle created substantial fuel loads that led to stand-replacing fires, and a cyclic successional trajectory that perpetuated both vegetation pattern and associated disturbance regime. Lodgepole pine dwarf mistletoe probably led to increased fire intensity in infected stands. The serotinous cones of lodgepole pine provided a competitive post-fire establishment advantage. Even in stands that contained small amounts of lodgepole pine, stand-replacing fires favored pine regeneration and, potentially, future successions of pure lodgepole pine.

Subalpine fir forests existed under a wide range of conditions; departures from the general fire regime existed. Where subalpine fir was bounded downslope by dry Douglas-fir forests, such as on the Chelan and Entiat Ranger Districts and in the Swauk LSR, the fire regime included more frequent, less intense fires. Low and moderate intensity fires originating in dry Douglas-fir stands burned into subalpine fir forests and only became stand-replacing when fuels and weather conditions were favorable. Mortality from these fires was patchy, favoring more shade-tolerant Douglas-fir, subalpine fir, and spruce. Trees scorched or scarred by low and moderate intensity fires became susceptible to insects and pathogens.

Fire extent in subalpine fir forests was a function of weather patterns and landscape patchiness. Strong winds drove fires until fuels were exhausted, often at the upper treeline. In some areas, subalpine fir forests consisted of groups of trees (islands) surrounded by talus or other substrates that did not promote stand-replacement fires. In such instances, fires killed some groups of trees and left others. Historic fire return intervals in subalpine fir forest were not always long. In a study in the central Washington Cascades, Woodard (1977) documented much shorter (15 - 40 years) fire return intervals in subalpine fir forests. In some instances, shorter intervals occurred because mortality from one fire fueled the next fire (Everett and others, study in progress; other citations).

Two introduced insects potentially threaten subalpine fir forests: the larch casebearer and the balsam woolly adelgid. Casebearer damage on the Wenatchee NF has been reduced by the introduction of predator species. Damage is now confined to short episodes of defoliation. Ultimately, this insect will cause much topkill in larch and reduce its growth, leading to increased stand dominance by subalpine fir. Subalpine fir is especially vulnerable to the woolly adelgid west of the Cascades crest; damage in eastern Washington is most likely to occur where the subalpine and grand fir series intergrade (personal observations of R. Mitchell, reported in Hessburg and others 1994).

## **G. Whitebark Pine/Subalpine Larch Forest Group**

### **1. Historic Disturbance Regimes and Primary Disturbance Agents**

#### **a) Whitebark pine:**

Historically, seral whitebark pine stands were maintained by stand-replacing fires in upper-elevation subalpine fir and mountain hemlock forests. Seeds cached by the Clark's nutcracker gave the species a competitive advantage in colonizing the interior of large burned areas. On sites where the combination of cold, wind, and late-summer drought precluded the formation of closed forest, open stands of climax whitebark pine occurred. Although upper slopes and ridges in the whitebark pine series were frequently struck by lightning, fuels were sparse, limiting the extent of historic fires. The fires that were ignited by lightning in 1994 provide an example of the pattern of storm activity where this series occurs. Lightning strikes that killed individual trees and small clumps were probably more common than ground fires. Fire return intervals are not known for whitebark pine ecosystems on the Wenatchee National Forest. In Montana, Arno (1980) documented a wide range of fire return intervals, 60 to over 300 years.

A number of insects attack whitebark pine; mountain pine beetle is the most important, although regeneration can be affected by several associated cone worms (McCaughey and Schmidt 1990). Historically, whitebark pine was not susceptible to most pathogens. Small trees can be killed or sustain mechanical damage from rodents or bears. Abrasion by wind-driven ice crystals sometimes cause extensive damage to open-grown trees.

#### **b) Subalpine larch:**

Subalpine larch is primarily restricted to the northern portion of the Wenatchee NF. It rarely occurs south of Mount Stuart. Subalpine larch is extremely long-lived and seldom suffers serious damage from insects or pathogens. Individual trees or clumps are sometimes killed by direct lightning strikes; spreading fires are not common, because fuels are discontinuous. Abrasion by wind-driven ice crystals can damage trees.

### **2. Current Disturbance Regimes and Primary Disturbance Agents**

#### **a) Whitebark pine:**

Whitebark pine is the climax species on only a small portion of its range; under historic fire regimes, whitebark pine dominated early and mid-successional stages within high-elevation, dry subalpine fir plant associations (Lillybridge and others 1995). The whitebark pine forest type appears to be declining in the Washington Cascades. Possible reasons for this decline include infection by white pine blister rust, a disease introduced from Europe in 1910 that has caused extensive mortality in five-needle pines in North America. There is at least one report of blister rust mortality in an eastern Cascades whitebark pine forest as early as the 1930s (J. Hadfield, pers. comm.). Recent aerial

Created Opening (Mesic Sites) (20)	Moderate	Low	Moderate	Moderate	Moderate
Single Layered (Mesic Sites) (21)	High	High	Moderate	Moderate	High
Layered/Mature (Mesic Sites) (22)	High	High	High	Moderate	High
Open Park-Like (Mesic Sites) (23)	Moderate	Moderate	Moderate	Low	Moderate

**Moist Forest Group (Grand Fir/Mesic Western Hemlock)**

Created Opening (Moist Grand Fir) (30)	Moderate	Low	Low	Moderate	Moderate
Single Layered (Moist Grand Fir) (31)	High	High	Moderate	Moderate	High
Layered Mature (Moist Grand Fir) (32)	High	High	High	High	High
Partial Cut (Moist Grand Fir) (33)	High	High	High	High	High
Created Opening (Mesic Western Hemlock) (34)	Low	Low	Low	Moderate	Low
Single Layered (Mesic Western Hemlock) (35)	Moderate	Moderate	Low	Moderate	Moderate
Layered/Mature (Mesic Western Hemlock) (36)	High	High	Moderate	Moderate	High
Partial Cut (Mesic Western Hemlock) (37)	Moderate	Moderate	Moderate	High	Moderate

**Subalpine Fir Group**

Created Opening (40)	Moderate	Low	Low	Low	Low
Created Opening of Avalanche Origin (40A)	Moderate	Low	Low	Low	Low
Single Layered (41)	Moderate	Moderate	Low	Low	Moderate
Single Layered of Avalanche Origin (41A)	Moderate	Moderate	Low	Low	Moderate
Layered Canopy (42)	Moderate	High	Moderate	High	High
Subalpine Park-like (43)	Moderate	Moderate	Low	Moderate	Moderate

**Wet Forest Group**

Created Opening (60)	Low	Low	Low	Moderate	Low
Created Opening of Avalanche Origin (60A)	Low	Low	Low	Low	Low
Single Layered (Sapling/Pole stands) (65)	Low	Low	Low	Low	Low

## **IV. Late Successional Associated Species**

### **A. Introduction for Wildlife Species**

In this chapter, information is presented about wildlife species that are associated with the late-successional forests and are either present or to be managed for in the LSR/MLSA's. A total of 80 species have been identified as being associated with these kinds of forest conditions and are known or suspected to occur on the Wenatchee National Forest. These include four mollusks, nine herpetiles, 42 birds and 25 mammals. The list of these species and the habitat types they are thought to be associated with can be found in Appendix 27.

A number of data sources were used to develop the list of late-successional associated species for the Wenatchee National Forest. These sources included district and forest databases, the Washington Department of Wildlife nongame database, species identified in the Scientific Analysis Team Report (Thomas et al. 1993), and the habitat associations guide developed by West (1976). In addition, the collective knowledge and vast experience of the wildlife staff on the forest were consulted to verify and amend this data.

In order to assess the effectiveness of wildlife habitats within the LSR/MLSA's road densities were determined. The roads database was updated by Ranger District personnel in order to complete this analysis. In addition, roads and trails data were used to conduct a Zone of Influence (ZOI) analysis (Servheen and Puchlerz 1994) to determine the availability of security habitat, defined as areas free from motorized vehicle use and high levels of non-motorized human activities.

Snags and down logs provide important habitat attributes for a variety of wildlife species. Because of this, it was important to evaluate the availability of this habitat within the LSR/MLSA's. This was accomplished by assessing the availability of snag habitat for all Fish Production Units (FPU) that include all or a portion of an LSR/MLSA. Information about past harvest activities within each FPU was obtained to determine effects to snag habitat.

In addition to consideration for the groups or guilds of species associated with the various kinds of late-successional forests, individual species assessments were also conducted. These assessments were completed for all threatened, endangered, sensitive, candidate, management indicator, survey and manage, and protection/buffer species that are known or could occur within LSR/MLSA on the forest. Collectively this group of species is referred to as species of special concern. This resulted in the addition of one mollusk, three herpetiles, 12 birds and eight mammals. This brought the total number of species being addressed in this assessment to 104. Information available about the status of these species is summarized in this chapter. However, relatively little is known about a number of them.

Inventories or surveys have been conducted for only a few of the wildlife species that are identified in Appendix 6. A summary of the survey and inventories completed to date and the species they have focused upon can be found in Appendix 27. Only four percent of the species addressed in this assessment have had 50 percent or more of their habitat within LSR/MLSA's surveyed or inventoried.

### **B. Late Successional Wildlife Species By Habitat Type**

#### **1. Dry Forest Group**

About 189,851 acres of the Dry Forest Group are located within LSR/MLSA's which comprises about 27 percent of these management allocations. The Dry Forest Group contains some acres of Mesic sites that could not be identified from modeled vegetation. A further explanation of this is provided in the "Vegetative Landscape" chapter. Fire-climax ponderosa pine forests historically dominated

distribution was highly variable within this vegetation group, as a result of variable disturbance regimes.

Wildlife species that are associated with LS conditions of this forest type and are of special management concern include: tailed frog, Van Dyke's salamander, Cascades frog, larch mountain salamander, Harlequin duck, northern goshawk, bald eagle, northern spotted owl, great gray owl, flammulated owl, pileated woodpecker, downy woodpecker, hairy woodpecker, white-headed woodpecker, black-backed woodpecker, three-toed woodpecker, red-breasted sapsucker, Williamson's sapsucker, northern flicker, little willow flycatcher, olive-sided flycatcher, chestnut-backed chickadee, pygmy nuthatch, elk, long-legged myotis, long-eared myotis, fringed myotis, Yuma myotis, western big-eared bat, silverhaired bat, pallid bat, marten, and fisher.

Mesic sites are capable of providing habitat structures that typically provide spotted owl foraging and dispersal habitat, while remaining within the range of natural variability. Nesting and roosting structure, such as dwarf mistletoe, are essentially part of this forest group, providing nest sites more often in the fire refugia on north slopes and benches. About 6,202 acres of the mapped mesic sites were also suitable spotted owl habitat. This is about 72 percent of the mesic site acres that were identified and about two percent of the total suitable spotted owl habitat within the LSR/MLSAs. The actual acres of suitable spotted owl habitat are considerably higher and should be identified during watershed assessments or project level evaluations. 55 spotted owl activity centers are located within the Dry and Mesic Forest groups, comprising 33 percent of the spotted owl activity centers known on the Wenatchee National Forest.

### **3. Moist Forest Group (Grand Fir/Mesic Hemlock)**

This vegetation group covers about 159,699 acres within LSR/MLSAs, covering 22 percent of these land allocations. Historically, fire occurred less frequently than in the Dry and Mesic vegetation groups, allowing successional advancement and complex habitat structures such as high crown closure, multilayering, and many snags and down logs. These conditions provide habitat for a wide array of wildlife species, including 54 species known or suspected to occur on the Wenatchee National Forest.

Currently, about 114,098 acres (71 percent) of the Moist Grand Fir group that are within a LSR/MLSA are in a late-successional condition. In the absence of any major disturbance, it is expected that in 50 years 133,440 (84 percent) acres and in 100 years 153,072 acres (96 percent) of this habitat would be in a late-successional condition.

Sustainable snag and coarse woody debris levels were estimated and are shown in detail in Table 17. The snag levels ranged from 14 to 25 snags per acre >10" DBH. Coarse woody debris ranged from 25 to 40 tons per acre in a variety of diameter classes. Snag recruitment and distribution was historically quite variable across the landscape due to the variability in the frequency and intensity of disturbances, such as fire and insects.

Wildlife species that are associated with LS conditions of this forest type and are of special status include: common loon, Harlequin duck, northern goshawk, bald eagle, marbled murrelet, northern spotted owl, great gray owl, flammulated owl, peregrine falcon, pileated woodpecker, downy woodpecker, white-headed woodpecker, black-backed woodpecker, three-toed woodpecker, red-breasted sapsucker, Williamson's sapsucker, northern flicker, little willow flycatcher, olive-sided flycatcher, chestnut backed chickadee, black-capped chickadee, red-breasted nuthatch, pygmy nuthatch, tailed frog, spotted frog, Cascades frog, larch mountain salamander, Van Dyke's salamander, warty jumping slug, blue-gray tail-dropper, papillose tail-dropper, Columbia pebblesnail, long-legged myotis, long-eared myotis, fringed myotis, Yuma myotis, silver-haired bat, western big-eared bat, pallid bat, elk, lynx, beaver, fisher, and marten.

The moist forest group is capable of providing structures that compose suitable spotted owl nesting, roosting, and foraging habitat while remaining within the range of historic variability. About 205,726 acres, including the wet forest group, currently provides suitable spotted owl habitat. This represents

## 6. Whitebark Pine/Subalpine Larch

Whitebark pine and subalpine larch are limited on LSR's/MLSA's across the Forest covering 3% (20,058 acres) of the LSRs and only a trace in the MLSA's. This forest group occurs in LSR's/MLSA's primarily in the north end of the forest, and in any large quantities (greater than 500 acres) on the Shady Pass, Sawtooth, and Chiwawa LSR's.

The whitebark pine forest group is ecologically important and is in a decline, due to insects, diseases and fire exclusion. It provides habitat for the very high elevational species, such as ptarmigan, spruce grouse, lynx, wolverine, mountain goats, golden mantled ground squirrels, golden eagles, and specifically a seed source for Clark's nutcracker. Recent research is finding a relationship between whitebark pine and the Clark's nutcracker, which is a species of interest. Renewal of forest structure through underburning can result in sustainable habitat for these species.

Sustainable snag levels and downed logs were not measured, due to limited studies and availability of habitat. However, all snags and logs are important to be retained on site, should any action within LSR's or MLSA's occur in this forest group.

## C. Wildlife Species Specific Information

The information presented in this section provides an overview of what is known about the species identified in Appendix 6 as species of special status. Information is provided on a species by species basis whenever it is available.

### 1. Endangered And Threatened Wildlife Species

There are six wildlife species and one critical habitat that are federally listed as Threatened or Endangered, and are known or suspected to occur within a LSR/MLSA. These include the bald eagle (*Haliaeetus leucocephalus*), northern spotted owl (*Strix occidentalis caurina*), peregrine falcon (*Falco peregrinus*), gray wolf (*Canis lupus*), and grizzly bear (*Ursus arctos*), marbled murrelet (*Brachyramphus marmoratus*) and Critical Habitat Units for northern spotted owl.

#### a) Bald Eagle

Bald eagles are currently known to occur within 16 (59%) of the LSR/MLSA's. Surveys for bald eagles have been conducted over about 21 percent of the available habitat within the LSR/MLSA's. There have been 33 bald eagle recovery territories identified on the Wenatchee National Forest (Rees 1989). Of these seven are located completely within a LSR/MLSA and portions of 11 are located within LSR/MLSA's. There are five known occupied territories on the forest, two are within an LSR/MLSA, the Tieton LSR and Tumwater MLSA. Winter roosts occur along major rivers with open waters during winter freeze, such as along the Columbia and Wenatchee Rivers.

#### b) Peregrine Falcon

Peregrine falcons were known or suspected to be present in seven (26%) of the LSR/MLSA's. Surveys have been conducted across about 11% of the habitat within these areas. The Forest has two active nest sites, one in the Haystack MLSA and one just off National Forest lands between the Tieton LSR and the Lost Lake MLSA. There is a hacking site in the Crow MLSA. A pair of peregrine falcons were located between the Tumwater MLSA and the Icicle LSR.

#### c) Spotted Owls

Currently there are 230 known spotted owl activity centers on the Wenatchee National Forest. Of these, 156 activity centers are located within an LSR/MLSA. There are an additional 74 activity centers located in Matrix, AMA and Wilderness. The activity centers in Matrix and AMA are unmapped LSR's. The objectives for retaining these activity centers outside LSR's/MLSA's, is

smaller trees, more open crown closure, but still multi-layered forest. On the Wenatchee, spotted owl nests sites include a proportionally higher amount of dwarf mistletoe and snags than the surrounding stands (Buchanan et al, 1987). Dense pole-sized and mature forest stands are used by spotted owls for dispersal habitat, which provides connectivity to suitable habitat, for genetic interchange within and between LSR's and MLSA's.

Spotted owl activity centers were mapped into GIS, based on the latest (1995) locations for LSR/MLSA owls and the January 1994 locations for Matrix and AMA owls. The GIS analysis found 9 activity centers that were very close (less than 1/4 mile) to the LSR/MLSA boundaries. Considering possible mapping errors, these sites were included within the network 156 sites, and will need to field verified. These occur on 5 LSR's the Bumping, Deadhorse, Lucerne, Manastash and Tieton. Suitable spotted owl habitat (nesting, roosting, foraging) was modeled across the Forest for consistency in analysis. Suitable habitat was based on forest vegetation and structure. Project level analysis will need to field verify and photo interpret this habitat and the spotted owl sites.

**Table 11, Spotted Owl Habitat and Activity Center Status**

LSR/ MLSA			Critical Habitat Units				Spotted Owl Activity Centers <sup>4</sup>		Suitable Spotted Owl Habitat (N/R/F) <sup>5</sup>	
Name		Acres in LSR/M LSA	Unit	Acres in LSR/ MLSA	% Acres in CHU	# Activity Centers Total	Dry Owls Total	Wet Owls Total	Total Acres	Percent
Boundary Butte	LSR		WA-11			2	2	0	@@@	
Bumping	LSR	14,989	WA-15	14,347	96%	7	0	7	9,238	62%
Chiwawa	LSR	107,044	WA-6	80,809	75%	17	10	7	49,489	46%
Deadhorse	LSR	18,319	WA-9	13,720	75%	9	8	1	6,692	37%
Icicle	LSR	14,289	A-10	5,222	37%	2	0	2	7,861	55%
Little Wenatchee	LSR	52,524	WA-7 WA-8	28,815 5,396	55%	9	0	9	29,534	56%
Lucerne	LSR	8,643			0%	1	1	0	3,454	40%
Manastash Ridge	LSR	104,661	WA-14 WA-34	77,410 4,890	74%	33	1	32	68,147	65%
Rattlesnake	LSR	10,484	WA-16	6,390	61%	3	0	3	5,632	54%
Sawtooth	LSR	15,246			0%	0	0	0	1,963	13%
Shady Pass	LSR	76,502	WA-4 WA-5	7,247 17,158	9%	4	1	3	42,224	55%
Slide Peak	LSR	1,658			0%	0	0	0	258	16%
Swauk	LSR	107,962	WA-12	86,098	80%	24	18	6	45,675	42%
Teanaway	LSR	34,043	WA-12 WA-13	2,573 9,361	8%	5	2	3	16,352	48%
Tieton	LSR	39,998	WA-17 WA-18	12,391 8,107	31%	13	1	12	25,587	64%
Upper Nile	LSR	9,191			0%	3	0	3	6,136	67%
Camas	MLSA	1,545				0	0	0	541	35%
Crow	MLSA	12,479				5	0	5	9,950	80%
Eagle	MLSA	5,267				1	0	1	2,363	45%
Haystack	MLSA	24,644				8	6	2	9,998	41%

<sup>4</sup> Below Threshold: < 2,663 total suitable spotted owl habitat acres in 1.8 mile circle or < 500 total suitable habitat in 0.7 mile circle. At Threshold: 2,663 - 3,994 total suitable spotted owl habitat acres in 1.8 mile circle. Optimum: > 3,994 total suitable spotted owl habitat acres in 1.8 mile circle.

<sup>5</sup> Dry suitable spotted owl habitat includes vegetation code 12 where size/structure is multi-story greater than 9" DBH; mesic includes code 22; and wet includes codes 32, 36, 62, 64, and 42.

### e) Grizzly Bears and Gray Wolves

Gray wolves are known to occur within 5 (19%) of the LSR/MLSA's. Numerous unconfirmed (Class 2 and 3) sightings have occurred across the forest. Grizzly bears are known to occur within 2 (7%) of the MLSA/LSR's. An average of 10% of the habitat for grizzly bears and 20% of the habitat for gray wolves within the LSR/MLSA's has been surveyed. Both grizzly bears and gray wolves, along with many other wildlife species, benefit from aggressive access management. Research has shown that when road densities exceed 1 mile/square mile of habitat, habitat effectiveness for these species is greatly reduced (Mech et al. 1988, Fuller 1989, Mace and Manley 1993, USFWS 1993, Servheen and Puchlerz 1994). Security habitat is also important for these species. To maximize the level of security habitat it is recommended that a minimum of 70 percent of the LSR/MLSA be included in security habitat and that security habitat be distributed across vegetation types. In addition, it is recommended that open road densities not exceed 1 mile/square mile measured on an FPU basis. Definitions of open and closed roads can be found in the grizzly bear recovery plan (USFWS 1993).

### f) Marbled Murrelet

There are no known marbled murrelet observations on the Wenatchee National Forest. However, the range overlaps onto three LSR's the Manastash, Icicle and Little Wenatchee. The Crow MLSA also has some portions of the range. Marbled murrelets spend most of their day feeding on salt water fish, and during the breeding season return to land at night. Though they are marine birds, they breed on the mainland in contiguous old growth forests. The marbled murrelet "Near Zone" extends 40 miles inland from a marine environment, there is none of this on the Forest. The "Far Zone", 55 miles, is on the Forest. Marbled murrelets have been known to breed up to 60 miles inland from salt water, in low elevation forests. The low forested passes along the Cascade crest may provide habitat for breeding. Surveys for marbled murrelets have been conducted on the Forest, in Cle Elum and Naches Ranger Districts, however, no sightings have been recorded. Further direction for marbled murrelet can be found in the NWFP C-10.

## 2. Sensitive And Candidate Wildlife Species

There are 17 wildlife species that are on the R6 Sensitive Species list or are federal candidate species, and are known or suspected to occur on the Wenatchee National Forest. These include the Harlequin duck (*Histrionicus histrionicus*), goshawk (*Accipiter gentilis*), willow flycatcher (*Empidonax trailii*), olive-sided flycatcher (*Contopus borealis*), tailed frog (*Ascaphus trueii*), spotted frog (*Rana pretiosa*), Cascade frog (*Rana cascadae*), Columbia pebblesnail (*Fluminicola columbiana*), long-legged myotis (*Myotis volans*), long-eared myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), Yuma myotis (*Myotis yumanensis*), Western big-eared bat (*Plecotus townsendii*), lynx (*Lynx canadensis*), bighorn sheep (*Ovis canadensis*), fisher (*Martes pennanti*), and wolverine (*Gulo gulo*).

### a) Harlequin Ducks

Harlequin ducks are known to occur within 9 of the LSR/MLSAs. The average amount of habitat within LSR/MLSAs that has been surveyed for this species was 20 percent. Harlequin ducks nest on the ground and show a high fidelity to nest sites (Wallen and Groves 1989). Because of this they are highly susceptible to human disturbance during the nesting and breeding period. Once disturbed it is unlikely that they will relocate to a new nest site (Wallen and Groves 1989). Management of human access is important to assuring viable populations of this species.

### b) Goshawk

Goshawks are known to occur in 23 (85%) LSR/MLSAs. The average amount of habitat inventoried within these areas was 13 percent. Management of goshawk activity centers includes the designation of a minimum of 30 acres of the most suitable habitat around the nest site. In addition, a 400 acre post fledgling area (PFA) around each nest site is designated. At least 60 percent of the PFA should

(Banci 1994). Banci (1994) also suggested that refugia established for grizzly bears, wolves and cougars could accommodate habitat needs for the wolverine. Koehler and Aubry (1994) cited roads management as important because they could lead to human caused mortality of lynx. In addition, roads used by snowmobiles may provide access for coyotes into areas that were previously inaccessible due to snow conditions. Coyotes and lynx would then compete for foods.

#### h) Bighorn Sheep

Bighorn sheep occurred in 2 (7%) of the LSR/MLSAs and their population status and distribution is quite well known. Domestic sheep grazing in areas where bighorn sheep are located is an issue as domestic sheep spread disease to wild sheep.

### 3. Management Indicator Species

There are 13 wildlife species that are listed as management indicator species that are known to occur on the Wenatchee National Forest. These species include the pileated woodpecker (*Dryocopus pileatus*), downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), three-toed woodpecker (*Picoides tridactylus*), red-breasted sapsucker (*Sphyrapicus ruber*), Williamson's sapsucker (*Sphyrapicus thyroideus*), northern flicker (*Colaptes auratus*), ruffed grouse (*Bonasa umbellus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elephus*), beaver (*Castor canadensis*), mountain goat (*Oreamos americanus*), and marten (*Martes americana*).

#### a) Primary Cavity Excavators

This group of species includes the pileated woodpecker, downy woodpecker, hairy woodpecker, three-toed woodpecker, red-breasted sapsucker, Williamson's sapsucker, and northern flicker. These species require snag habitat and are capable of excavating their own cavities.

The number of LSR/MLSA's in which these species are known to occur includes: pileated woodpecker 22 (82%), downy woodpecker 16 (59%), hairy woodpecker 22 (82%), 3-toed woodpecker 12 (44%), red breasted sapsucker 5 (19%), Williamson's sapsucker 7 (26%) and northern flicker 27 (100%). Surveys have been conducted over an average of 2 percent of the available habitat within the LSR/MLSAs. Information on the current condition of snag habitat across the forest can be found in appendix ? and is described under the unique habitat section.

Primary cavity excavator habitat within LSR/MLSAs are to be managed to meet the 100 percent potential population level (Thomas 1979, ROD). Sustainable snag levels developed to meet these habitat needs within each forested vegetation type are described in table 17. There is also a recommended methodology for defining snag levels and monitoring at the site specific project level using a 40 acre monitoring grid. Within LSR/MLSAs the highest end of the snag density ranged that can be sustained on the site should be used.

#### b) Ruffed Grouse and Beaver

Ruffed grouse are known to occur within 13 (48%) LSR/MLSAs, and the average amount of their habitat that has been surveyed was 4 percent. Beaver are known to occur within 11 (41%) LSR/MLSAs, and the average amount of their habitat that has been surveyed is 9 percent. These species are both management indicators for riparian habitats. A part of their habitat needs are addressed in the Aquatic Conservation Strategy (ROD).

#### c) Mule Deer, Elk, and Mountain Goat

Mule deer and elk are known to occur within 27 (100%) of the LSR/MLSAs and their range and population status is relatively well known. Mountain goats are known to occur within 20 (74%) of the LSR/MLSAs, and surveys have been conducted on an average of 23 percent of their habitat. Human access levels pose significant management issues for these species. Management of road

d) Larch Mountain Salamander, Van Dyke's Salamander

Little is known about the distribution or abundance of these species on the Wenatchee National Forest. They were not known to occur within any of the LSR/MLSAs and no surveys have been completed within these management allocations.

Both of these species are identified in the ROD as survey and manage species. Survey strategy for these species includes surveying prior to ground disturbing activities and management of sites. Survey protocols are being developed and will be available spring of 1996. Surveys are to precede the implementation of any project implemented in FY 1997 or later. (USFS, 1994)

## D. Unique Habitats and Species

Unusual or rare habitats are viewed on different scales, the landscape level of unique ecosystems, and the microsite basis of unique habitats and species. The unique habitats and species across the Wenatchee National Forest and the adjoining lands are often microsite vegetative components or small sites, and can not be easily analyzed on a landscape basis. Unique habitats accommodates many federally listed species, Regional Forester sensitive species, and State Species of Concern. These habitats and species have been identified through: forest planning efforts in biological diversity (WNLMP pg 80-81, 104); Endangered, Threatened, Proposed or Sensitive Species (FSM 2670); Survey and Manage, Protection and Buffer species (NWFP pg C3-6, 11, 19-21, 26-28, 43-61); Watershed Assessments modules across the Forest; American Indian uses (NWFP C 16, E 9-10); and biodiversity "hot-spots" as identified in the Interior Columbia Basin Ecosystem Management.

### 1. Landscape Level

Unique ecosystems and areas of high degrees of biodiversity are viewed on a landscape level. The Interior Columbia Basin Ecosystem Management Project (1995) displayed areas of rarity or endemism for animals and plants (distribution centers) providing a landscape view at the relevance of species and habitats within, together and adjacent to each other. Habitats and the relative abundance on a larger scale can be analyzed. Fringe habitats are viewed for genetic interchange of pioneering, expanding or declining species. See Unique Species and Habitat Module Appendix page # 14-21. The Wenatchee National Forest Plan noted Research Natural Areas, Special Interest areas and unique botanical or geological areas, across the landscape (see map) @@@.

a) Rarity Areas Noted in Interior Columbia Basin  
Ecosystem Planning

The LSR/MLSAs which include distribution for both plants and animals centers, (rarity areas noted in Interior Columbia Basin ecosystem planning), are Little Wenatchee LSR, Icicle LSR, and Twin Lakes MLSA. Portions of Chiwawa LSR, Teanaway LSR and Lucern LSR are also included. LSR/MLSAs which include centers for plants only are Swauk LSR, Deadhorse LSR, Natapoc MLSA, Eagle MLSA, Tumwater MLSA, Boundary Butte LSR, Camas MLSA, Sand Creek MLSA. Portions of Shady Pass LSR and Chiwawa LSR are also included. Animal species richness are noted in Rattlesnake LSR, Russell Ridge MLSA and portions of Tieton LSR.

b) Research Natural Areas

The Wenatchee Forest Land and Resource Management Plan (pg Ch II 29-30) describes Research Natural Areas (RNAs) as: baselines against to measure effects of human disturbance; areas to study the natural process in undisturbed ecosystems; and provide gene pool preserves for all types of organisms, especially rare and endemic. LSR/MLSAs with RNAs or potential RNAs inside the boundary are: Teanaway LSR (Eldorado Cr); Swauk LSR (Drop Cr); Little Wenatchee LSR (Big Chief/Millbrook). LSR/MLSAs adjacent to RNAs or potential RNAs are: Haystack MLSA (Meeks

murrelets and northern spotted owls (ROD B 12-14). Serving as connectivity corridors between LSR's and MLSA's, Riparian Reserves are intended to provide adequate habitat conditions for dispersal of spotted owls and genetic interchange for late successional species. The forested connectivity module noted potential disruption to connectivity in the Snoqualmie Pass corridor

Stands of western red cedar are commonly associated with this group, as are some stands of aspen and cottonwood. Other sites may consist mostly of wet seeps or meadows supporting grasses and sedges. Associated shrubs are devil's club, alder, and willows. Sedges, monkeyflowers, common horsetail, and various mosses and liverworts may be present. Late successional riparian forest could potentially provide habitat for survey and manage vascular plants such as Victorin's grapefern and mountain moonwort, and for at least 25 survey and manage fungi and lichen species.

Riparian forests also provide habitat for approximately 109 wildlife species using various habitat types of riparian reserves. There are 60 species specialized towards riparian old growth or mature forest (see appendix 27). Riparian areas occur in all forest types and are used by wildlife more heavily than the adjacent vegetation type. Wildlife species representative of the aquatic riparian habitat guild is the tailed frog. The big brown bat and solitary vireo represent the terrestrial riparian habitat guilds

#### (1) Aquatic Riparian Habitat

Stream-dwelling species generally require cool water and are sensitive to siltation, which inhibits reproduction and foraging (FEMAT 1993, p. IV 143). Abundant amphibians in an area indicate a healthy habitat for mollusks such as fresh water snails, forest duff-layer slugs, and stream clams (Nussbaum et. al. 1983; FEMAT 1993 p. IV-135; USDA 1994c [J2]). Most amphibians have specific habitat requirements, such as being associated with headwater streams or coarse woody debris. Salamanders have low mobility and depend on moist environment for all phases of their life cycle. **Tailed frogs** are stream dwellers, occurring in clean, cold rocky streams. Feeding upon insects in the stream or adjacent moist areas (Leonard et al 1993), much of their live cycle takes place underwater in fast-moving streams. The adults lay eggs/larvae under rocks and debris in and adjacent to streams. They forage up to 450 feet from stream (Metter 1964). For the animal to disperse outside the streamside zone, habitat adjacent to streams is cool and humid. High canopy closure is important for micro-site climate (Piper 1994). The tailed frog is a species of concern (USDI Fish & Wildlife Service, 1996).

#### (2) Terrestrial Riparian Habitat

Bats, as a group, are tied to Riparian Reserves for abundant snags, hollow roosting trees, shrub zone, forested areas, and woodlands for feeding. Old growth forest structure in the Pacific northwest provides these structural needs (Thomas et al 1993). **Big brown bats** roost singly, or in small groups, in large snags, caves, tunnels, and wooded areas. They prey mostly on beetles and woodland insects. Forested riparian areas with abundant snags, hollow trees, downed logs, and decaying trees are important for day time roosts and natal dens (Larrison 1970; Burt et. al. 1976; FEMAT 1993; USDA 1994c [J2]; Murphy 1994 [Bat Notes]). Other species known for using old growth riparian forest structure are Vaux's swift (Sharp 1992), marten, fisher, woodpeckers, owls, lynx, and bear..

The **solitary vireo** is a song bird that winters in the tropics and breeds during summer in coniferous forests. Forested breeding grounds are an important part of the ecology of this species. They nest in small conifers in riparian forests. They feed in tree tops and shrubs, eating woodland insects found on twigs and foliage (Terres 1987; Scott 1987). A mixture of shrubs and forests provide excellent habitat for this species and others such as the varied thrush, forest snails, some bat species, and many song birds (Piper 1993 and 1994, Andelman et. al. 1994; Sharp 1992). The solitary vireo is a neotropical migratory bird in a population decline, as are Cooper's hawk, kestrel, mourning dove, calliope hummingbird, western wood pewee, tree swallow, veery, Swainson's thrush, orange-crowned warbler and yellow warbler.

#### (3) Water Riparian Habitat

Meadows provide habitat for deer, elk, big-horn sheep, black bear, grizzly bear, coyote, gray wolf, bob cat, lynx, snowshoe hare, deer mouse, mountain vole, pocket gopher, long-tailed vole, grouse, raptors, hummingbirds, swallows, song birds, amphibians, mollusks, and butterflies.

(2) Shrubfields

(a) Shrubfields

**Shrubfields** are non-riparian areas supporting mixes of shrubby hardwoods. Important characteristics include width of openings, wet or dry vegetation, abundance of berries or flowers, size or age of vegetation cover. Wildlife utilizing this habitat are song birds, hummingbirds, great-horned owl, bears, deer, elk, moose, small mammals.

(b) Avalanche Chutes

**Avalanche chutes** are typically dominated by alders and vine maple. Herbaceous cover is variable. Important characteristics include avalanche chute width and length, elevational and precipitation zones, size or age of vegetation cover. Wildlife utilizing this habitat are bears, song birds, small mammals, and land snails.

(3) Hardwoods

This group consists of scattered, non-riparian stands of aspen, cottonwood and bigleaf maple. Associated understory species may include Rocky Mountain maple, red alder, serviceberry, hawthorn, chokecherry, and Scouler's willow.

Wildlife species utilizing hardwoods and associated shrubs are mule deer, black bear, grizzly bear, deer mouse, ruffed and blue grouse, woodpeckers, western wood-peewee, ash-throated flycatcher, western tanager, black-headed grosbeak, warbling vireo, chestnut-backed chickadee, cedar waxwing, and evening grosbeak.

(4) Talus, Caves, Cliffs and Rock Outcrops

**Talus, caves, cliffs, and rock outcrops** provide important substrate for many sensitive plant and animal species. Bears will pull over talus boulders to search for moths hibernating during day. Many of the survey and manage bat species are tied to cliffs. Rock outcrops provide habitat for peregrine falcon, as well as mountain goat. To function favorably for these species, rocky areas need the adjacent forest structure to provide thermal protection during hot or inclement weather, and cover to reduce disturbance or predation. Plants typically occur in rock cracks or scattered clumps of soil between rocks. Some associated species are ferns, sandworts, sedges, and grasses. Wildlife associated with rocky outcrops, talus, caves, and cliffs are pika, pocket gopher, bats, Larch Mountain salamander, flycatchers, lizards, cougar, bobcat, peregrine falcon, bear, and wolverine.

c) Forest Groups of contiguous patches, dry forest old growth, disjunct forest groups and snags/logs.

These forest groups are unique when in infrequent distributions, limited locales, and unusual composition. These unique forests provide connectivity for narrow ranging species, such as mollusk, small mammals, fungi and lichen, as well as dispersal corridors for wider ranging species such as flying squirrel, marten, fisher, wolverine and gray wolf. They also provide for disjunct plant and animal species which may be on the edge of the range, or in population declines or a localized pioneer of an expanded range.

(1) Forest Interior - Connectivity Patches

This forest group includes areas of **large forest connectivity and forest interior** (of which Manastash LSR, Shady Pass LSR, Bumping LSR, Icicle LSR, and Crow MLSA all have high amounts). High quality forest interior is in moist, wet, deep forests, without the warming effect of the edge on the functioning forest (Spies 1990, Harris 1984). The forest interior is internal to a forest

abundance of snags and downed logs. Known sites on the Forest include the recent (1994) burns on the Chiwawa LSR, Boundary Butte LSR, Icicle LSR, Deadhorse MLSA and Tumwater MLSA. Older burns in the Little Wenatchee LSR, Shady Pass LSR,

#### d) Survey and Manage Species & Protection and Buffer Species

Survey and Manage species, and Protection and Buffer species were developed to meet biological concerns for species closely associated with late successional forests. Most late successional associated species had a high likelihood of species persistence as a result of actions in the NWFP. The buffer concept was developed for species that needed additional protection. Buffering occurs around locations of species with additional needs or different habitats from those protected by actions for spotted owl, marbled murrelets, or riparian reserves.

Unmapped LSRs were developed for spotted owl, marbled murrelet, great gray owl, 5 fungi and 2 mosses (bryophytes) which occur in Matrix or AMA. Unmapped MLSAs were developed for Larch Mountain salamander, 2 fungi and 2 mosses.

Included in survey and manage species are great gray owl which primarily is located on the northern portion of the Forest, mollusks, Larch Mtn salamander on the Cle Elum District, lynx on the northern portion of the Forest, and Survey and Manage vascular plants, bryophytes, fungi and lichen. These are located within and outside LSRs and MLSAs. Surveys have not been conducted for many of these species at this time, so little is known about the range and abundance of these species on the Forest and within LSR/MLSAs. See Wildlife and Plant species lists, and Unique Habitat Table for LSR/MLSA for more information.

Included as protection and buffer species are the dry forest woodpeckers, nuthatches, flammulated owls as well as the bats, lynx, spotted owl activity centers outside of LSR/MLSA, marbled murrelet outside LSR/MLSAs.

##### (1) Spotted Owl Activity Centers

Spotted owl activity centers in Matrix, AMA and Wilderness provide connectivity for smaller ranging species, such as lichen and mollusk which have difficulty traveling between 6 and 12 miles between LSR/MLSAs. In the northern portion of the Forest, most spotted owl activity centers are within LSR/MLSAs. However, on the Cle Elum district, there are 13 sites within the AMA and 8 sites on non-federal lands. Connectivity within the AMA is needed to provide for north-south and east-west genetic interchange, which is vital for viability concerns. The Naches district has 5 matrix spotted owl sites and 26 wilderness sites outside LSR/MLSAs. The portion of the Forest north of Lake Chelan does not have any documented pair or residential single spotted owl sites. The Sawtooth LSR is in this area and will have difficulty providing connectivity south to the Shady Pass and Lucerne LSRs. This connects with the Northern Province, adjoining the Okanogan Sawtooth LSR, which provides habitat for species other than spotted owls. These spotted owl activity centers, outside of LSR/MLSAs, are important for retaining the best 100 acres of habitat and for protecting habitat around these sites, which provides for late successional forest associated species overtime (ROD C 3,10,11,45).

##### (2) Drier Forest Owls and Woodpeckers

The dry forest types occur in most of the LSR/MLSAs on the eastern side of the Forest, from Shady Pass south to Tieton. The dry forest species were give special highlighting due to the decrease in these species, as forests become more dense with control of wildfire. Many of the woodpecker, nuthatch and flammulated owl are tied to fire as part of their life cycle. See section above for more detail.

##### (3) Bat Species

Bats have a special emphasis for riparian, snags, caves, and cliffs. Little is known of bats, but they seem to be declining throughout their ranges. Not much is known of bats on the Forest. Naches

## **E. Late-Successional Associated Plant Species**

### **1. Introduction**

In this section, information is presented about plant species (here the term "plant" is used to refer to fungi, lichens, bryophytes, and vascular plants) that are associated with the late-successional habitats (according to FEMAT) that are present or would be managed for within LSR's or MLSA's. It is important to note, however, that some species discussed in this section can be found in more early or mid-seral stage communities. Defining habitat requirements becomes difficult for species that have broad ecological amplitude. Habitat requirements for plants may be provided for in a large portion of a particular sere. It is difficult if not impossible to state that a plant is found only in late-successional forests. Therefore, an attempt will be made to describe habitat requirements for individual or groups of species rather than successional status. This habitat description may or may not equate to late-successional forests as described elsewhere in this document. A logical stratification for discussion of species/habitat is by forest group.

Information regarding species habitat requirements for plant species discussed here is lacking. Some information can be found in the FEMAT Report (1993), the ROD and appendices, or other literature. We have relied heavily on the knowledge of botany/ecology staff on forest for most species information.

This section will also attempt to discuss the function of the LSR and MLSA network across the Wenatchee National Forest. Apparently, few, if any, studies have attempted to describe connectivity of habitat patches for late-successional plant species. A forest-wide overview is provided here, while individual LSR or MLSA chapters provide more specificity.

### **2. Vascular Plant Species by Habitat Type**

Vascular plants are the dominate life forms of most terrestrial ecosystems. As a group, vascular plants are known as tracheophytes meaning that they possess specialized water-conducting tissues made primarily of cells called tracheids. The group can further be divided into seed-bearing (angiosperms and gymnosperms) and spore-bearing (ferns, horsetails, and clubmosses) plants. These organisms are the primary producers of ecosystems converting the sun's energy into carbohydrates which provides food for heterotrophic organisms. In forest systems, vascular plants create structure, both vertical and horizontal, and perform a variety of functions such as habitat provision, nutrient cycling, water storage, and others.

Vascular plants have economic value as well. Conifers and hardwoods provide our society with wood fiber for building homes, making paper, manufacturing furniture, just to name a few. Many flowering plants are used in horticulture, medicine, landscaping, and crafts. In the Pacific Northwest, forest products provide the regional with millions of dollars annually (FEMAT 1993).

The Wenatchee National Forest has a diversity of vascular plants with some species which are strictly endemic. FEMAT (1993) provides a list of 126 vascular plant species which are thought to be closely associated with late-successional or old-growth forests. Again, it should be pointed out that many of these species are not completely restricted to late-successional forests. Those species that were addressed in FEMAT were subjected to "screens" to determine viability under the 9 alternatives considered in the FEIS (1994). The species that still had viability concerns under the implementation of the selected alternative become survey and manage species under the ROD. Species under the survey and manage provision are to be addressed by one or more of four survey strategy components: manage known sites (1); survey prior to ground-disturbing activities (2); extensive surveys (3); and general regional surveys (4). six of these species occur within LSR's or MLSA's on the Wenatchee National Forest (Appendix 27). A general discussion of these species are provided in this section, but only survey and manage species listed in the ROD will discussed later in the document.

### a) Federal Candidates

Currently there is only one federal candidate plant species, *Sidalcea oregana* var. *calva*, within the LSR's or MLSA's on the Wenatchee National Forest. This species occurs within the Sand Creek MLSA (DM-7) and the Boundary Butte LSR. Currently there are only 5 known locations, 3 of which are on National Forest Lands.

A status report was completed in 1987 and a federal listing packet was developed in 1995. A conservation agreement between the Forest Service, U.S. Fish and Wildlife Service, Washington State Department of Natural Resources, and Longview Fibre Corporation was completed in 1995 in conjunction with a former federal candidate, *Delphinium viridescens*.

Prior to the fall of 1995, there were a number of federal candidates on the Wenatchee National Forest. In the November of 1995, the U.S. Fish and Wildlife Service placed all category 1 and 2 candidates on a separate list called "species of concern" (Plant Candidate Update 11/20/95, Memo from Assistant Regional Director, USFWS). These species would now need to be proposed to become a candidate and then a listing packet would need to be developed for listing and protection under the Endangered Species Act. A list of federal species of concern is provided in Appendix 6.

### b) Washington State Endangered, Threatened, or Sensitive

The Washington Natural Heritage Program maintains a list of plant species which require careful management and assigns them an endangered, threatened, or sensitive status. Endangered means that plants are in danger of becoming extinct or extirpated in Washington; Threatened means plants are likely to become endangered in Washington; and Sensitive means that plants are vulnerable or declining and could become endangered or threatened in Washington. A list of these species is provided in Appendix 6.

The Natural Heritage Program works closely with the botany staff on the Wenatchee National Forest providing recommendations for species conservation or assisting in the preparation of status reports, conservation agreements, or conservation strategies.

### c) Regional Forester's Sensitive Species List

The Regional Forester of Region 6 provides a list of "sensitive" species which receive special consideration in forest management. Many of the species are the same as the Washington State Endangered, Threatened, and Sensitive list.

### d) Survey and Manage

Vascular plant species that are to be surveyed and managed are listed in Appendix 6 along with their survey strategy(ies). Appendix J2 of the FEIS provides biological and management recommendation information for each survey and manage species.

*Cypripedium fasciculatum* is a state threatened species and a federal species of concern as well as a survey and manage species. It is known from a number of locations on the Wenatchee National Forest and is present in five LSR's and four MLSA's. A number of research projects are in progress or have been completed in the last 4 years for this species. Information gathered from these projects is being used to develop a conservation strategy. Appendix J2 of the FEIS provides some general management guidelines which are being implemented on a project by project basis.

*Botrychium minganense* and *B. montanum* are also known from a number of locations on the Wenatchee National Forest and are present in two LSR's and two MLSA's. Both species have previously been considered sensitive in Washington State, however, *B. minganense* was recently (1994) moved to the state monitor list because of its abundance in the state. Appendix J2 of the FEIS

Lichens play a major ecological role in late-successional ecosystems. They are primary producers, accumulating biomass and carbohydrates, and contributing to forest nutrient cycling (Pike 1978). Their litterfall provides organic matter to soil and increases the soil moisture-holding capacity (FEMAT 1993). Several lichens function to fix atmospheric nitrogen and make it available to organisms which cannot utilize it in this initial form (Denison 1973, Hawkworth and Hill 1984). By capturing fog, arboreal lichens contribute to retention of moisture in the forest canopy (FEMAT 1993). The forage lichens are a major food source for small animals such as flying squirrels (Maser et al. 1985). They are also a food source for deer, elk, and mountain goat during the winter (Hodgman and Bowger 1985; Fox and Smith 1988). Lichens provide habitat and food for canopy-dwelling invertebrates (Gerson and Seaward 1977), are used by birds and small mammals for nest building (Broad 1989), and by reptiles and amphibians as camouflage. Lichens are valuable as biological indicators, useful for assessing air quality, water quality, and the presence of heavy metals (McCune 1988, ROD). Other species provide an indication of climatic conditions such as snow depth. Several species function as indicators of forest age and ecological continuity (FEMAT 1993). Lichens are recognized for their social and human value, as well. Some species show potential for antibiotic and medicinal opportunity (Hawkworth and Hill 1984; Hale and Cole 1974). American Indians use lichens as food and weaving material (Turner 1990). They are also utilized as craft material and as a source of dye (Hale and Cole 1974; Turner 1990).

The lichen flora supported on the Wenatchee National Forest is diverse and includes species representative of both east-side and west-side forest communities. FEMAT (1993) provides a list of 157 lichen species which are known to be closely associated with late-successional forests. Lichens were assigned to a functional group based on ecological relationships and degree of rarity. The Record of Decision (1994) identified 81 of the 157 species to be protected through survey and management standards and guidelines. These species are primarily indicative of west-side climatic regimes, however, several species have been documented east of the Cascade crest in and adjacent to the Columbia River Basin (Ryan 1994, WSU records, District Species lists. A general discussion of the Survey and Manage species documented or suspected to occur on the Wenatchee National Forest by functional group and forest vegetation group follows.

#### a) Dry Forest Group and Mesic Forest Sites

There are seven lichen species from the Survey and Manage list suspected to occur within dry forest vegetation in LSR's and MLSA's on the Wenatchee National Forest. There are an additional 31 species suspected to occur within mesic Douglas-fir sites included in this group. In general, species thought most likely to occur in the driest portion of this group tend to be nitrogen-fixing lichens such as *Nephroma parile*, *Peltigera* spp., and *Pseudocyphellaria anomala*. These species are typically associated with montane and woodland forests and occur on soil, mossy rocks, and at the base of coniferous and deciduous trees. The function of nitrogen fixation in these communities is potentially important. In other communities, where lichens are abundant on the soil, modification of soil qualities, or inhibitory actions on mycorrhizal fungi or grasses, might be important (Ryan 1994). In addition to the nitrogen-fixing lichens, a forage lichen (*Bryoria tortusa*), a pin lichen (*Cyphelium inquinans*), and a riparian lichen (*Collema nigrescens*) are also suspected to occur in the dry vegetation group.

Historically, in fire-maintained communities such as the dry forest types described here, it is likely that these lichen species were only a minor component of the ecosystem. The occurrence of these species was likely restricted to the moist Douglas-fir inclusions and moister micro-sites within this group. As a consequence of the extremely slow growth rates of lichens and relatively short fire-return intervals, establishment of extensive populations of these species was probably not likely. Heavily-stocked stands of Douglas-fir and grand fir, which have resulted from fire exclusion, have likely provided an opportunity for several of these species to become established or become more abundant than historically. In contrast, species which may have

their fruiting bodies in the forest environment, are typically of the taxonomic groups Basidiomycetes, Ascomycetes, and Zygomycetes. Thousands of species of soil mycoflora have been identified and are known to form complicated cooperative and antagonistic relationships with actinomycetes, bacteria, amoebae, protozoa, and nematodes which also interact with plant roots in the rhizosphere (Watanabe 1994).

Relationships of fungi to higher plants have frequently been studied from the aspect of mycorrhizal relationships. Most land plants form some kind of mycorrhizal relationship with fungi. Fungal species have varying sizes of host ranges. Narrow ranges are typically genus specific, while intermediate and broad ranges extend across diverse plant families and orders (Molina et al. 1992). Concomitantly, plants also have a similar spectrum of compatibility and utility of fungal species. Relationships of fungi with animals are also frequently cited. Truffles are hypogeous fungi that have evolved a dependence on animal consumption for spore dispersal. For example, the northern flying squirrel (*Glaucomys sabrinus*), the primary prey of the northern spotted owl has evolved a dietary dependence on these fungi (Forsman et al. 1984, Maser et al. 1978).

Economic uses of fungi as Special Forest Products have increased in the recent years. While collection for ornamental and fabric dyeing uses occurs, the preponderance of utilization is as food. This collection of fungi has turned into a multi-million dollar enterprise in the Pacific Northwest. The harvest of a half million pounds of fungi occurred in Washington in 1990 (Molina et al. 1993), while nearly a million pounds were collected in 1992 (Schlosser and Blatner 1994). As world production fluctuates, demand and subsequent value increases, and other employment opportunities in the woods decline, commercial mushroom collection will continue to experience growth (Schlosser and Blatner 1994). FEMAT (1993) recognized this resource's social and ecological implications and included Standards and Guidelines for the management of some of these species, most notably chanterelles (*Cantharellus* spp.).

The Wenatchee National Forest provides a large range of forest habitats and consequently provides a great diversity of substrates for forest fungi. Originally, the 527 species of fungi listed in FEMAT were considered for analysis here. This list was refined to incorporate only the 234 species of fungi listed in the ROD, which are thought to be closely associated with late-successional or old-growth forests, although not exclusively so. The refinement of the FEMAT list to the current ROD list resulted in the ROD list consisting of species that were known only from type localities, were rare or endemic to the Pacific Northwest and potentially could become extinct with extirpation, or were commercially harvested species. Continued commercial harvest, particularly for chanterelle species, was a concern because it may affect species viability by potentially decreasing distribution, frequency, reproduction, and productivity, as well as genetic variability of species (J2, FEIS 1994). These Survey and Manage species are to be accommodated by one or more of the four survey strategies previously described (Strategies 1-4, C-4, ROD).

Records of these fungal species for the Wenatchee National Forest are scarce. Information on these species for the Vegetation Groups listed below has been compiled from forest and district botanist's collections and observations, museum and herbaria records, or more commonly, by extrapolation of limited information on range to potential like habitats or substrates. The limited local knowledge and inconsistency and ephemerality of fruiting are the major obstructions to collecting comprehensive distribution and occurrence records. (See Appendix 7 for a complete list of species and references).

#### (1) Dry Forest Group

There are four documented Survey and Manage fungal species (*Cantharellus subalbidus*, *Gyromitra esculenta*, *Gyromitra montana*, *Spathularia flavida*) within late successional reserves on the Wenatchee National Forest for the Dry Forest Group (refer to the Appendix @@@). Two of these are cup fungi that often appear after fire or other disturbance (Tylutki, 1979). The third is a chanterelle species that occurs on those dry sites with an elevation of at least 1500 feet. Other suspected species are hypogeous (below ground fruiting) truffles and false truffles which can be widely distributed but may not fruit often (e.g., exist primarily as mycelium, etc.) or are difficult to survey for because of

species diversity, abundant moisture, and wide range of locations across the landscape on the Wenatchee National Forest likely contribute to this high value of collected fungal species.

(5) Subalpine Fir Series and Whitebark Pine/Subalpine Larch

For these two Vegetation Groups, only one species has been collected. Of 25 fungal species for Subalpine Fir, 16 are suspected. Of eight fungal species for Whitebark Pine/Subalpine Larch, five are suspected. As with the Dry Vegetation Group, important rare fungi may be under represented in the Whitebark Pine/ Subalpine Larch Group due to a minimal amount of studies and limited collections.

b) Fungal Species Specific Information

Nonvascular "plants," including fungi, have only recently been considered for special status. Difficulties in recognizing life-forms, variability and ephemerality of fruiting bodies, and the limited numbers of professional specialists have contributed to this situation. Special status means that individual species occur on the federal candidate list, state endangered, threatened, or sensitive list, and/or on the survey and manage list in the ROD.

(1) Federal Candidates

No fungal species are currently listed with the U.S. Fish and Wildlife Service as Endangered, Threatened, Proposed, or Candidate species at this time (T. Thomas, USFWS, pers.comm. Feb. 27, 1996). A current moratorium on the listing of any new species will preclude the inclusion of any fungal species for the foreseeable future.

(2) Washington State Endangered, Threatened, or Sensitive

There are no species of fungi currently listed with the Washington Department of Natural Resources, Natural Heritage Program as Endangered, Threatened, or Sensitive (ETS) at this time. It has been proposed that the Natural Heritage Program will solicit academic and professional botanist input in the fall of 1996 to determine what species may qualify for special status (J. Gamon, WDNR, pers.comm., Feb. 27, 1996). The suggested strategy was to compile a list of species to be designated "Rare" in the near term until enough information can be collected to determine where in the established categories (ETS) these species may fit.

(3) Survey and Manage

The 234 species of fungi listed in the ROD are recorded in Appendix 7 with their survey strategies. Appendix J2 of the FEIS (1994) provides biological and management recommendation information for each of these species. Three species of rare cup fungi, *Aleuria rhenana*, *Helvella compressa*, and *Bryoglossum (Mitrula) gracile*, are listed without strategies but recommendations in J2 reflect strategies 1 and 3. There are 22 species known from the Wenatchee National Forest, most being on the Lake Wenatchee Ranger District where incidental surveys have taken place. The remaining species not recorded for the Wenatchee National Forest have varying probabilities for their occurrence there. There are at least 40 more species suspected on the Wenatchee National Forest based on known distribution of species, available habitats and substrates, and regional collections.

Many species listed in the ROD, including 27 new species not yet fully classified, are unlikely to occur on the forest. Coastal habitat species, species known only from Oregon or California, and species known only from a type locality or restricted locations would be included here. Caution should be exercised in exclusion, however, as range and distribution information for most species are extremely limited due to incomplete or total lack of surveys. There are 64 hypogeous or subhypogeous species of fungi listed. Some of these may be commonly occurring species but are difficult to survey for.

Two species of note are the polypores, *Oxyporus nobilissimus* and *Bondarzewia montana* that are suspected on the Wenatchee. These fungi are listed as survey strategy 1,2,3 species. These are the

## **V. Aquatic Systems**

### **A. Historic Aquatic Conditions**

The lands contained within the Wenatchee National Forest and adjacent to it have been influenced by Euro-American populations since the 1700's. The anadromous and resident population of fish and resident aquatic mollusk populations have changed significantly between the beginning of these influences and today's conditions. The habitats they require have progressed through a series of changes over the same period. "Our analysis of changes in fish habitat and the chronology of settlement and land use suggests a different response for each basin because of the timing and duration of human disturbance events, acting individually and synergistically. (McIntosh et. al., Feb. 1994)

Human use has changed from the impact of a relatively low number of individuals whose life style was seasonally nomadic, to a high number of individuals whose population is resident. Fish populations have been inversely proportional to the human populations. Historic estimates for total fish run size within the Yakima Basin is 790,000 fish, with the present run size at 7,018. (McIntosh et. al., Feb. 1994) Fish harvest rose from harvests of a few hundred thousand fish caught annually by the native populations, to more than 40.3 million pounds of salmon harvested along the Columbia River in 1884. Current salmon harvest levels are significantly reduced from that level.

Mining opportunities, as early as 1858, caused an inflow of people and changed sediment input rates. Grazing animals effecting the uplands and the riparian vegetation changed from some level of native herbivores to hundreds of thousands of domestic livestock the late 1800's. The level of grazing was reduced after the turn-of-the-century, but was high again during the World Wars. Grazing allotments are still being used on the Wenatchee National Forest.

Some fish and wildlife species were introduced to the Wenatchee National Forest by humans hoping to improve the sport and subsistence fishing and hunting. Unfortunately these introduced species compete with native wildlife and fish populations.

Timber harvest had direct impacts on the rivers, as logs were driven down the major water courses to the mills and the rivers were harnessed for power at mill sites. Water diversions for irrigation, power and other uses began when the American Indian population were taught by the missionaries to divert water to their garden plots in the 1850's. The current number of impoundment's, dams and water diversion sites have grown in numbers parallel to the human population in the region. The Columbia River system contains eleven major dams or locks and six large storage reservoirs within or below Wenatchee National Forest lands. The earliest reservoir, Bumping Lake Dam, was completed in 1910 and the last large dam on the lower reaches of the Columbia River was completed in July 1968.

Concern about the impacts human use has had on the aquatic resources was recorded in the actions taken by the state government at the turn of the century. Close to the same period Federal agency leaders and local government officials agreed that there was reason to be concerned about the future of aquatic resources.

### **B. Current Conditions**

"Fish habitat has shown some improvement from past abuses in eastern Washington, while continuing to decline in eastern Oregon. This appears to be the result of different land-use histories in the two regions." (McIntosh, et. al., Feb. 1994) Aquatic resources, especially fish are important to the people of the state of Washington. "According to the Washington State Game Department's 1977 Annual Report, about 700,000 people, or nearly a quarter of the population of the state are licensed

The Wenatchee National Forest has been collecting water temperature data and monitoring streams since 1989. While there is little data from streams whose uplands have not had many recent management activities; there is data available from the major streams and rivers. Generally, based on available data, the most severe temperature problems occur in the mainstem rivers. Private land ownership and/or rail road and highway right-of-ways probably play important roles in the higher than desirable temperatures. High temperatures cause acute stress to a variety of aquatic species. Chronic temperature stress can reduce individual and population fitness and alter aquatic community structure.

"Pools and substrate composition are important to resident fishes and anadromous salmonids for all phases of their freshwater life. Pools provide rearing habitat for juvenile fish, resting habitat for adult fish before spawning and refugia for adults and juveniles from catastrophic events such as drought, fire and winter-icing. (Sedell and others 1990, McIntosh et. al., Feb. 1994) Historic activities impacted most of the drainages from headwaters to mainstems and impacted stream quality. Over the past 50 years, there has been a trend toward increasing large pool habitat in both recently managed and un-managed drainages. (McIntosh et. al., Feb. 1994) Data on sediment movement rates is not easily interpreted with the limited amount of historic data available.

"The frequency of large woody debris and debris complexes is about 50 per cent greater in unmanaged streams than in managed streams." "The frequency of large woody debris has decreased in managed systems because of extensive debris removal programs initiated in the 1950's and continued into the 1980's, along with riparian timber harvest." (Sedell and others 1991) The removal of large woody debris in managed stream contributes to decreased habitat complexity and cover, higher stream temperatures, reduced sediment storage, sediment routing capabilities and the instability of stream channels and floodplains. (McIntosh et. al., Feb. 1994)

"The loss of species diversity [in Riparian Reserves] from land-use practices has altered fish community composition and reduced species diversity." (Bisson and Sedell 1984, Bisson and others 1992, Reeves and others 1993, McIntosh et. al., Feb. 1994)

Before 1900, there were few developed roads in the upper drainages. Between 1962 and 1990, over 280 miles of road were constructed. Road densities ranged from .6 to 1.9 mi/sq. mi. in 1990 (B. Ehinger, McIntosh et. al., Feb. 1994) "A considerable body of literature has demonstrated the detrimental effect of fine sediments on salmonid reproduction (Chapman 1988, Everest and others 1987)" (McIntosh et. al., Feb. 1994) Roads within the riparian zone are a large contributor to sediment input into streams.

## 1. Wenatchee National Forest's Key Watersheds

Key Watersheds were recognized by the 1990 resurvey and analysis by McIntosh et. al. team. The identified watersheds were offered to serve as cornerstones to regional protection and restoration efforts for aquatic systems. The criteria for selection were based on studies by Johnson and others (1991) and Reeves and Sedell (1992). Key watersheds were larger than 15 km sq. and contained relatively high-quality water and fish habitat, or had the potential to provide high-quality habitat with appropriate restoration efforts; and contained habitat for threatened or potentially threatened anadromous and resident fish species. The watersheds were selected by Federal, State and Tribal fish biologists from across the region. (Final EIS on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl. Pages 3 & 4-69 through 82.)

**Columbia River:** passage to upstream key watersheds

**Yakima River:** passage to upstream key watersheds

## VI. Human Uses

### A. Forest Overview

The Wenatchee National Forest is a publicly owned natural area of marvelous beauty, diversity, and productivity. The Forest includes a net area of 2,164,180 acres. It is about 140 miles long and 25 to 55 miles wide, stretching from spectacular Lake Chelan in the north through the rugged Goat Rocks Wilderness in the south. It begins at the very crest of the Cascade Range in Central Washington State and falls sharply to the breaks of the Columbia River. Elevations on the Forest range from 800 feet to more than 9,500 feet, encompassing three major landforms and more than 30 different geologic formations.

Within the Forest, the eastern slopes of the Cascades are drained by four major drainage systems: the Chelan, Entiat, Wenatchee and Yakima drainages. The Naches and Tieton drainages are major subdivisions of the Yakima system. All flow eastward, eventually draining into the Columbia River.

### B. Recreation

This wealth of water, wildlife, and scenery plus dependably sunny weather attract millions of recreation-minded visitors to the Wenatchee Forest. With nearly 5 million visitor days of use recorded each year, the Forest is one of the half dozen most heavily visited National Forests in the nation. People come to camp, hike, fish, hunt, to take in the scenery, to take pictures, ride horses, drive 4-wheel-drive vehicles and ride motorbikes, to rockhound and pan for gold, to cut firewood, to gather mushrooms, and pick berries. In winter they come to ski (downhill and cross-country), to snowshoe, ride snowmobiles, and play in the snow. This recreation activity is a key ingredient in the tourism industry that has become a key cornerstone of the central Washington economy.

Recreation use is heaviest in the summer months, but occurs in all seasons of the year. In the early spring, hikers, horse users, and trail bike enthusiasts flock to low elevation trails. These activities follow the melting snows upward during the summer until fall storms begin to push users back down into the valleys. Scenic highways and forest roads are equally attractive to visitors, and driving for pleasure is one of the most popular public recreation uses of the Forest. There are 126 campgrounds and picnic areas offering visitors a rustic camping experience for a few hours or for several days.

#### 1. Trails

An important recreational feature of the Wenatchee National Forest is the trail system. The following table displays trail information:

Table 13 - Wenatchee National Forest Trail Miles

District	Wilderness Miles	Total Non-Motorized, Non-Wilderness	Motorized Miles <sup>1</sup> , Non-Wilderness	District Total Miles
Chelan	173.8	18.2	64.6	256.60
Cle Elum	164.7	229.2	302	695.90
Entiat	56.6	32.4	197.8	286.80
Lake Wenatchee	211.5	99.9	52.9	364.30
Leavenworth	227.9	35.5	54.4	317.80

At the turn of the century the Wenatchee National Forest was grazed heavily by thousands of sheep. Today commercial grazing on cattle and sheep allotments continues on the Wenatchee National Forest. In addition to commercial grazing some recreational grazing occurs from equestrian use of trails and wilderness areas.

## **H. Minerals**

The geology of the Forest is lithologically, mineralogically and structurally very complex. Because of its geologic complexity, the Forest has potential for the occurrence of a variety of mineral resource commodities including, but not limited to, gold, silver, copper, lead, zinc, geothermal, coal, limestone, asbestos, garnet, pumicite, oil and gas.

The Forest has approximately 11,000 mining claims covering 200,000 acres properly recorded. Only a very limited number of these claims will actually experience exploration and development activities. At present, even though there is a relatively high amount of on-going exploration, prospecting and mineral related recreation activities, mineral production activity from the Forest is relatively minor in scope.

Recreational use of the mineral resources is also present with activities such as gold panning, rockhounding and the use of small suction dredges. Even though there are about twenty kinds of minerals recreationally collected on the Forest; placer gold, agate, quartz crystals, garnet, talc or soapstone, olivine, rhyolite, pyrite, rhodenite and actinolite appear to be the main targets of collectors. The areas experiencing the most activity of this nature appear to be the Red Top, Big Creek, Kachess Lake, White River, Cle Elum Lake, Peshastin, Negro, Ruby and Swauk Creeks, Wenatchee Ridge, Manastash Creek and Deep Creek areas. However, there is also interest in other localized areas.

## **I. Land Status**

About 293,199 acres, or 12 percent of the land within the Forest boundary, is not National Forest land. Many of these lands are in a "checkerboard" ownership pattern. Most of this checkerboard ownership is in the center of the Forest in the vicinity of Stevens (U.S. 2) and Snoqualmie (I-90) Passes and along the east side of the Forest. Much of the intermingled private land is managed for timber production by large corporate landowners. Almost all of it is within the roaded portion of the Forest and only a minor amount is within wilderness or other unroaded areas. This pattern is evident on the Forest map.

Other agencies also manage land within the Forest. The Washington State Department of Natural Resources manages more than 30 square miles of land scattered throughout the northeast part of the Forest (primarily Sections 16 and 36). The Washington Department of Game manages about 10 square miles of land within the Forest boundaries, and the Washington State Parks Commission manages about one square mile of land at Lake Wenatchee State Park.

The Bonneville Power Administration has several major energy transmission corridors on the Forest. Currently there are three major energy utility corridors crossing the Forest through Stevens, Snoqualmie and Stampede Passes. The rights-of-way for these lines are from 100 feet to 1,400 feet in width and they occupy about 1,420 acres of National Forest land. In addition to these lines there are many miles of powerline on the forest providing local electrical service to rural areas.

The subdivision and development of private lands within and adjacent to the Forest is accelerating. Such changes impact public land management associated with fire protection, access, sanitation (water quality), trespass, wildlife management and habitat modifications. There are also demands to preserve the natural environment in proximity to summer homes or year-round residences. This creates pressure to restrict management options on activities such as timber harvesting and road, trail and campground construction.

enrolled tribal members of the Yakama Indian Nation and other Indian groups specified in the treaty language secured:

The exclusive right of taking fish in all the streams where running through or bordering said reservations {Yakama Reservation defined in Article 2}, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land. (Yakama Indian Treaty of 1855)

The Northwest Forest Plan (FEIS pg. 3&4-314 to 319) includes discussions about American Indian People and Cultures associated with protection of tribal treaty rights and trust resources. Pertinent sections of this document are included here to provide insight into the intent of the NWFP.

“The duty to protect the treaty reserved rights of American Indian tribes is an obligation of all federal agencies.”

“Habitat, and therefore the environment, is critical to the protection of those rights, and tribes need to be consulted regarding proposed management activities that may affect levels of plant and animal populations.”

“In addition to the treaties and rights reserved by various tribes, the federal agencies must comply with other statutes that concern American Indians. The American Indian Religious Freedom Act of 1978 (AIRFA) supports the Indian right to practice religious beliefs.”

“The proposed action will not alter or affect these rights and interests nor will it impose any extra conservation burden on the tribes or Indian reservations.”

A section of the ROD (pg. 54 and 55) provides further insight:

“This decision provides a higher level of protection for American Indian trust resources on public lands than the plans that it amends, and does not impair or restrict the treaties or rights of tribes. It is conceivable, however, that subsequent implementation of standards and guidelines could directly affect American Indian practices and activities – for example, a prohibition against the collection of certain plant material or trees in late-successional reserves that are subject to tribal treaty off-reservation gathering rights. Under such circumstances, the exercise of these tribal treaty rights will not be restricted unless the Regional Interagency Ecosystem Office determines that the restriction is (1) reasonable and necessary for preservation of the species at issue, (2) the conservation purpose of the restriction cannot be achieved solely by regulation of non-Indian activities, (3) the restriction is the least restrictive alternative available to achieve the required conservation purpose, (4) the restriction does not discriminate against Indian activities either as stated or as applied, and (5) voluntary tribal conservation measures are not adequate to achieve the necessary conservation purpose.”

LSR/MLSA management activities proposed by this assessment and subsequent activities tied to this assessment, will give consideration to these treaty rights associated with traditional American Indian use of forest resources.

## **M. Historic Conditions**

The cultural resource base of the Wenatchee National Forest includes a diverse and unusually rich range of historic and prehistoric artifacts and sites. These include: 1) historic cabins, trails, mines, ditches, railroad grades, emigrant trails, original highway grades, mills and homesteads; 2) historic

## **VII. Forest-Wide LSR/MLSA Assessments**

In developing this assessment outline the LSR Assessment Team discovered there were a number of discussions needed to fully provide background information and complete this assessment document. This chapter includes these key discussions. The following summary provides an overview of each section.

### **“Assessment Modules”**

These modules provide a process for developing the individual LSR/MLSA assessment chapters and determining the rationale for any proposed activity within these areas. The entire set of modules is included in Appendix A.

### **“Desired Conditions”**

This section discusses the desired conditions for various resources associated with LSR/MLSA's.

### **“Sustainability”**

This section provides an introduction to the principles of sustainability of late successional habitat in the LSR's and MLSA's and outlines the process used to analyze sustainability in this assessment. An overview of sustainability for all the LSR's and MLSA's is provided.

### **“Function of the LSR/MLSA Network”**

This section introduces concepts and relationships pertinent to the network function of these areas

### **“Fire Management Plan”**

This section includes a fire management plan relevant to management of all the LSR/MLSA's across the forest. It also displays a summary of expected wildfire ignitions and acres burned for each LSR/MLSA.

### **“Opportunities for Restoration and Maintenance”**

One of the important products of this assessment are the activities that would be implemented to achieve the management goals and objectives for LSR/MLSA's. This section provides a general introduction to restoration and project opportunities. More specific activities are included in each individual LSR/MLSA chapter.

### **“Future LSR/MLSA Assessments”**

This section lists the LSR/MLSA that will have assessments completed in the near future.

## **A. Introduction to the Assessment Process**

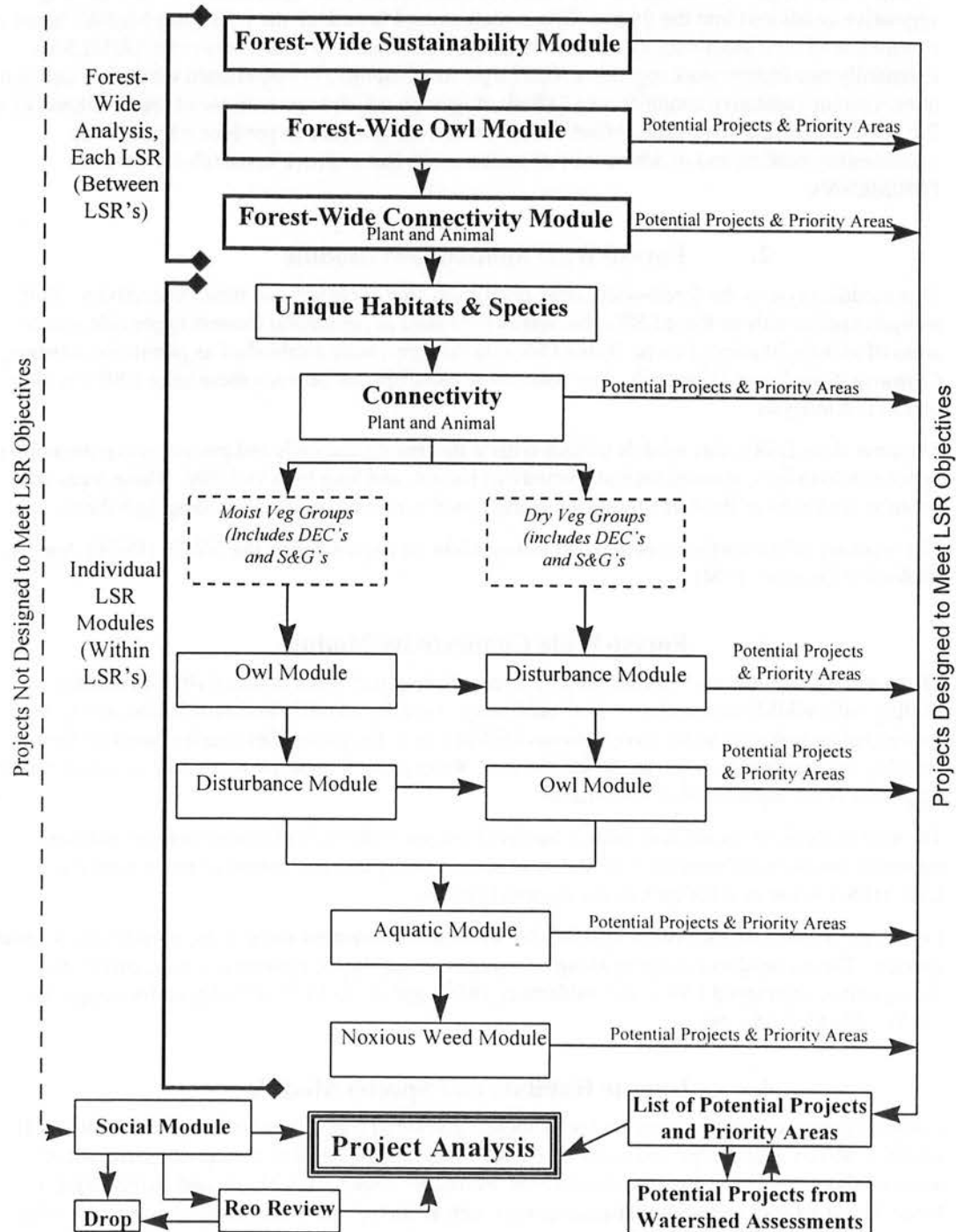
One of the important objectives of this assessment was to develop an understandable, consistent and streamlined process for assessing each LSR/MLSA. Not only should this process provide the framework for the forest-wide assessment but it would provide the foundation for future individual LSR/MLSA assessments on the forest. To realize this objective the team developed a process that is visually displayed in the flow diagram on the following page. Each of the solid outlined boxes represent a more detailed module that provides guidance in developing the assessment. These modules are contained in the Appendix.

The process begins at the top with three forest-wide modules on sustainability, owls, and connectivity. In addition to looking at the forest-wide picture, these modules analyze things going on between LSR/MLSA's. Once the “Forest-Wide” modules are completed the remaining modules focus on the individual LSR/MLSA (starting with the “Unique Habitats and Species” module). These modules analyze things going on within the individual LSR/MLSA's. After the Connectivity module, the Spotted Owl Module and Disturbance Modules are processed in an order dependent upon the

**Figure 3, Forest LSR Analysis Flow Chart**

(Refer to Appendix A for Detailed Module Information)

## LSR Analysis Flow Chart



The Snag Module provides a landscape scale analysis for LSR/MLSA snag, green tree recruitment and downed log qualitative assessment. It envelopes the wildlife and plant species dependent on this forest structure, as well as quantitative analysis of habitat conditions. Snags and downed logs may be plentiful, but not in the sizes and species of need. This module illustrates the condition and potential treatments.

## 5. Species With Special Status Module

Within each LSR or MLSA, information is gathered regarding species with special status (i.e. federal candidate, sensitive species, or survey and managed species: refer to "Late al Associated Species" section above) to determine potential maintenance or restorations projects and priorities (Fig. ?). The analysis begins by determining if there are *immediate* viability concerns. Obviously, viability concerns exist for those species that have special status, but it is important to determine if individual species are nearing extirpation in the near future (<10 years). If there are immediate viability concerns, it is important to distinguish between biological/ecological (maladaptedness) and human induced causes for species decline. Extinction is a natural process, but extinction as a result of human activities is not desirable. This is because rare (candidate or sensitive) species may represent a step in diversification that is critical to the survival and/or maintenance of species or species groups (Harrod et al. 1996a). It will be important to ascertain whether or not rare species are newly evolved or represent maladapted relic species nearing extinction. If species decline is human induced, federal candidate species receive first priority for project consideration (Fig ?). A conservation strategy or recovery plan will need to be developed to document thought process and address related issues. When no immediate viability concerns exist, monitor species populations and develop conservation strategies as time and money allow. Projects that are outlined in conservation strategies are divided into two types: habitat improvement and augmentation/introduction. Habitat improvement projects improve environmental conditions for species with several populations. Examples include, but are not limited to: burning, improving hydrologic condition, eradicating competitive weeds, changing canopy closure, and managing human activities (off-road use, climbing, collecting, and grazing). Habitat improvement for *Delphinium viridescens* through thinning and burning provides an example of this type of project (information available at the Leavenworth RD). Knowledge of the species biological and ecological requirements will be necessary to determine appropriate habitat improvement. Augmentation/introduction projects are used as a last resort. Species with only one or few populations that are imperiled should receive top priority for augmentation/introduction. This will require recovery plans which are developed with interagency cooperation. Introduction of *Hackelia venusta* provides an example of this type of project (information available at the Leavenworth RD).

## 6. Connectivity Module (Within LSR/MLSA)

This analysis focuses on habitat connectivity between LSR/MLSA's, the focus is on mobility between late successional patches within the LSR/MLSA. Both natural and human caused barriers to specie mobility are identified and those that are human caused can lead to potential restoration activities that improve connectivity.

## 7. Disturbance Module

The disturbance module analyzes the fire, insect and pathogen risk for each LSR / MLSA. The risk to catastrophic wildfire is developed using both the forest-wide sustainability module, the juxtaposition of vegetation types within or adjacent to each LSR / MLSA, and additional factors specific to a particular LSR / MLSA, including ignition risk from lightning and/or human use and fuel loadings.

For insects and pathogens, each vegetation type was rated as having either a low, moderate, high, or no risk with respect to the insects and pathogens associated with each type of vegetative composition and structure. Insects and pathogens analyzed include western spruce budworm, Douglas-fir beetle, mountain pine beetle, western pine beetle, dwarf mistletoes of ponderosa pine, western larch,

## C. Desired Ecological Conditions (DEC) and Desired Future Conditions (DFC)

### 1. Desired Ecological Conditions for Forest Vegetation Groups

The following is a description of the "desired" ecological conditions for vegetation within the LSR's and MLSA's on the Wenatchee National Forest. An overall objective would be to provide for biologically diverse ecosystems (ROD, B-1) that represent the range of natural variability (Harrod et al. 1996a, Morgan et al. 1994, and Swanson et al. 1994). The ROD states that an objective of LSR's is to help ensure late-successional species diversity (ROD, B-5) and that maintaining and restoring diversity of watersheds is judged by whether or not biological and physical processes are within their ranges of natural variability (ROD B-10 and B-11). Diverse systems are resilient because of the variety of structures, number of species, and different successional stages present in the landscape (Harrod et al. 1996a). This objective is consistent with the overall objectives of the watershed(s) in which each LSR or MLSA occurs (where watershed assessments have been completed). There are four levels of diversity that can be discussed in context of desired ecological conditions for LSR's and MLSA's which are presented below.

#### a) Genetic and Species Level Diversity

At the genetic and species level, the goal would be to maintain or restore genetic variability within and among plant species within the LSR's and MLSA's. Of particular concern are rare species including sensitive species, species which are endemic to the Wenatchee Mountains (the only place on the Forest where endemics occur), or disjunct populations. A species should only be considered rare because of its maladaptedness or being recently evolved, and not because management activities are contributing to its decline (Harrod et al. 1996a, Falk and Holsinger 1991).

Plant species distribution across the landscape would be representative of individual species demography. It would be undesirable to disconnect required habitats so that species populations could no longer exchange genetic material.

Species diversity would be commensurate with that expected under historic conditions for particular community types. In other words, species diversity would be representative of the range of natural variability for forest communities within forest groups.

A goal would be to eliminate non-native species establishment and spread. The reason being that non-native species can contribute to native species decline, thereby decreasing biodiversity at the species level (Harrod et al. 1996a, Harrod et al. 1996b, Harrod 1994). The ROD indicates that non-native should not be introduced into LSR's (ROD, C-19).

#### b) Community and Landscape Level Diversity

At the community and, to a lesser degree, landscape level, the goal would be to restore the distribution, composition, structure, and function of communities within the range of natural variability (Harrod et al. 1996a, Morgan et al. 1994, and Swanson et al. 1994). The impetus for this approach can be found in the ROD, B-10 and partially on B-1, B-4, and B-5. Specifics are given by forest group below.

##### (1) Dry Forest Group

The goal would be maintain across the landscape the majority of this forest group (>80%) at lower basal areas (60-80 ft<sup>2</sup>/ac), with lower tree densities, and dominated primarily by ponderosa pine (Avery et al. 1976, Wickman 1992, Agee 1993, Mutch 1993, Agee 1994). The specifics of species composition and diameter distribution would vary depending on site specific information. For example, preliminary results from one study on the Leavenworth RD in the Mission Creek Watershed

Late-successional stands would best be maintained in fire refugia such as riparian areas or headwalls of basins (Camp 1995). Species composition should favor ponderosa pine, Douglas-fir, and western larch, but again, this will vary depending on site specific information.

As with mesic sites in the dry forest, it may be appropriate to promote and/or maintain a higher proportion of this forest group as late-successional stands to provide suitable habitat for spotted owls (see DEC for spotted owls). Again, sustaining late-successional habitat within this forest group will depend largely upon restoring fire climax communities in the surrounding dry forest landscape.

Understory species composition would be variable, but a shrub understory would dominate most associations. Important shrub species include *Holodiscus discolor*, *Symphoricarpos* spp., *Acer circinatum*, and *Berberis nervosa*. Higher percentage graminoid component would be present in those stands that are in drier sites within this group.

Again, the best means of maintaining mid- or late-successional stands characteristics within this forest group will be to lessen the chance of stand destroying fires in the dry forest group which is often directly adjacent and intermixed with this group. In addition, having a mosaic of stand types distributed across the landscape will favor a fire regime with low to moderate intensity.

#### (b) Mesic Hemlock Sites

The goal for the mesic hemlock in terms of stand structure and landscape pattern would be similar to that for the moist grand fir. However, species composition would differ. A number of early seral species including western larch, Douglas-fir, western white pine, and lodgepole pine would be present in early and mid-seral stands. Because a historic moderate fire regime in mesic hemlock sites, true late-successional stands were probably limited in distribution. The desired ecological condition would be to maintain or restore mid- or late-successional stands where appropriate.

#### (4) Wet Forest Group

In the more moist sites in the western and mountain hemlock series and the silver fir series, the landscape would be dominated largely by late-successional forest communities. Diversity in these forest communities would be created by insects and disease, avalanche chutes, etc., while large, infrequent (200-400 years) fires would occur. In the mountain hemlock series on drier sites, whitebark pine would be present as an early successional dominant. Early successional stages would be maintained by periodic lightning caused fires.

Species composition would be highly variable because three forest series have been combined in this group. Seral dominants would include Douglas-fir, western larch, lodgepole pine, Engelmann spruce, and grand fir. Understory composition would also be highly variable and depend upon the forest series. In some cases, understories may be depauperate while in other cases it may be very lush with a dominate shrub component.

These forests, particularly the silver fir and western hemlock series are the best place to sustain conditions that are necessary for spotted owls (see DEC for spotted owls). Long disturbance free intervals, high canopy closure, structural diversity, and large contiguous habitat patches are best maintained over the long-term (50-100 years) in the wet forest group.

#### (5) Subalpine Fir Group

This series would consist of early to mid-successional forest communities with layered, late-successional communities located in fire refugia. Surface fuels are similar to the moist grand fir forest group, but the crown form promotes torching and crowning (see disturbance section). The objective is to have a landscape that functions under a high fire severity regime (80% high intensity fire, 20% low intensity fire) (Agee 1993).

Species composition would consist of lodgepole pine and Engelmann spruce as seral dominants, and subalpine fir as the climax species. Understory composition would be variable depending on site conditions. Contiguous forest environments would be forb and graminoid dominated with such

In order to make the finding that a project or management action "meets" or "does not prevent attainment" of Aquatic Conservation Strategy Objectives, the analysis must include a description of the existing conditions, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the proposed project or management action maintains the existing condition or moves it within the range of natural variability. Other management actions should not be implemented. (p. B10, NWFP)

#### b) Components of the Aquatic Conservation Strategy

(Note: Pages listed below are in NWFP)

1. Riparian Reserves - are designated to provide a high level of fish habitat and riparian protection. B-17, C-30.
2. Key Watersheds - are designated areas that either provide or are expected to provide high quality habitat. B-19, C-7.
3. Watershed Analysis - focuses on implementing the Aquatic Conservation Strategy and implementing Ecosystem Management. B-30.
4. Watershed Restoration - will be an integral part of a program to aid recovery of fish habitat, riparian habitat and water quality, based on Watershed Analysis planning. B-32.

#### c) The Hierarchy Of Standards And Guidelines By Land Allocation Occurs In This Order. (ROD A 5)

1. Congressionally Reserved Areas.
  2. Late Successional Reserves
  3. Adaptive Management Areas
  4. Managed Late Successional Reserves
  5. Administratively Withdrawn Areas
  6. Riparian Reserves.
  7. Matrix
- Key Watersheds - which can overlap any allocation. The allocation's Standards and Guidelines apply plus those of the Key watershed.
  - In all allocations the Standards and Guidelines that provide greater benefit to Late-successional forest related species apply (p. C-3 for exceptions.)

#### d) Elements of the Aquatic Conservation Strategy Objectives,

**Desired future condition is to:**

1. Have maintained and restored the distribution, diversity, and complexity of watersheds and landscape-scale features that protect the aquatic systems, species, populations, and communities which are dependent on them.
2. Have maintained and restored the spatial and temporal connectivity within and between watersheds. The networks provide unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species.
3. Have maintained and restored the physical integrity of aquatic systems, including shorelines, banks and bottom configurations.
4. Have maintained and restored the water quality necessary to support healthy riparian, aquatic and wetland ecosystems. Water quality remains within the range that maintains the biological, physical, and chemical integrity of the system.
5. Have maintained and restored the sediment regime under which the aquatic ecosystems evolved.

need to be monitored through Regional review, and incorporate newer research as it becomes available.

Within MLSA's, home ranges for spotted owls will provide short term (20 to 50 years) habitat for the species recovery. There will be at least 40% (2,663 acres) of the home range in late-successional forest suitable for nesting/roosting/foraging.

Any habitat improvement projects needed to meet LSR objectives should occur in habitat in the following order: first in unsuitable, then in dispersal, then in foraging, then in roosting and lastly in nesting. Protection of nest sites from human activities includes reducing disturbance during the critical nesting period. Spotted owl activity centers will have a timing restriction between March 1 and August 31, within 1/2 mile of the nest site. This is to allow the greatest protection of disturbance during the breeding season. Spotted owls in the Eastern Cascades generally complete breeding and start dispersal by August 31, individual cases may require modified dates or disturbance buffers.

Unmapped LSR's will have at least 100 acres of the highest quality habitat available. Carefully managed lands around these Activity Centers will provide for residual habitat areas, while blending with timber harvest (NWFP C3,10-11,39,45,D9; FSEIS App 3-4 pg. 241, FSEIS App G 24-25, App B11). See Unmapped LSR Chapter in Chapter XII.

#### c) Genetic Dispersal Within and Outside LSR's/MLSA's

Dispersal habitat allows for movement of individuals within LSR/MLSA's. Dispersal habitat also allows for movement between LSR/MLSA's for spotted owls. This dispersal habitat would be provided through the provision of riparian reserves, plus other provisions in Matrix (NWFP FSEIS App G page 41, 1994) such as unmapped LSR's, 15% of late-successional habitat in a watershed, protection and buffer sites, survey and manage sites, and wilderness.

Connectivity between large owl clusters is crucial to long-term persistence and viability of the spotted owl. The combination of LSR/MLSA network, protection for occupied sites within Matrix and AMA's, riparian reserves, should provide for the survival of a spotted owl population that is stable and self-sustaining on Federal lands (NWFP FSEIS App G page 19-20, 1994). Important connectivity corridors have been identified within LSR/MLSA's and between LSR's/MLSA's (see individual LSR/MLSA chapters for more information).

#### d) Sustainable Spotted Owl Habitat

Spotted owl habitat will be maintained, where capable of sustaining habitat. The moist and wet forest groups have more sustainable spotted owl habitat, as they have less large scale disturbance associated with them. A higher risk may be assumed in the dry and mesic forest groups, when an individual owl home ranges are below threshold, in the large cluster LSR's, and in key dispersal connectivity corridors. A method to determine habitat sustainability and the inherent disturbance regime is to develop a model based on vegetation type, aspect, precipitation, configuration on the slope, fuels/fire hazard. See Probability Model for Late Successional Fire Refugia (Camp 1995). A stand level analysis can assign risk and sustainability to spotted owl habitat, activity centers and home ranges. See Forest Wide Spotted Owl Module and Individual LSR/MLSA Spotted Owl Module.

#### (1) Desired Biological Condition For Spotted Owl Habitat in LSR's/MLSA's, By Vegetation Group.

1. Moist Forest and Wet Forest - These forests provide the best spotted owl nesting habitat, over time. A 60-100% crown closure, multi-story stand. Snag densities are 25 to 40 snags per acre in areas with green tree recruitment, 29 to 50 snags per acre in areas devoid of green tree recruitment. Logs will be 25 logs to 70 logs per acre for pileated woodpecker and marten needs. Western hemlock, Douglas-fir, Pacific silver fir, whitepine, grand fir, western larch and ponderosa pine would be 20 to 60 TPA at 21"± DBH (27' to 47' spacing), and multi-story stand. (50 to 100 Years).

## (a) Nesting And Roosting Habitat

(Federal Register , page 1798 and Thomas et al. 1990): This habitat typically includes a moderate to high canopy closure (60 to 80 percent); multi-layered, multi-species canopy with large (>30 inches diameter at breast height (dbh) overstory trees; a high incidence of large trees with various deformities (e.g., large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for owls to fly. There are variations in features such as tree diameter and canopy closure between vegetation types and over the owl's range.

## (b) Foraging Habitat

(Federal Register Page 1798) Spotted owls use a wider array of forest types for foraging, including more open and fragmented habitat, although less is known about the characteristics of foraging habitat. Habitat that meets the species' needs for nesting and roosting also provides for foraging. However, habitat that supports foraging does not always provide the other constituent elements and is not considered adequate for other purposes.

## (2) Dispersal Habitat

(FSEIS App G page 16): That which supports the life needs of an individual animal during dispersal. This habitat generally satisfies needs for foraging, roosting, and protection from predators. Guidelines for spotted owl dispersal habitat in the Final Draft Recovery Plan for the northern spotted owl include maintenance of stands of trees that average at least 11 inches dbh and have at least 40 percent canopy closure. At a minimum, dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities; there may be variations between vegetation types and over the owl's range. Dispersal habitat provides an important linkage function among blocks of nesting habitat both locally and over the owl's range that is essential to the owl's conservation.

#### 4. Unique Habitats and Species - Desired Ecological Condition

## a) Landscape Level

The desired ecological condition for the landscape scale of unique habitats and species would be to maintain or enhance subdrainage and Forest level components of biological diversity (WNF LRMP IV-104, 1990). The areas of species rarity and endemism for plants and/or animals which are noted in the Interior Columbia Basin Ecosystem Management Project will continue to function. The Research Natural Areas noted in the WNF LRMP will continue to function. The unique areas of biodiversity noted in the WNF LRMP will continue to function. This landscape level approach will compliment and strengthen the LSR and MLSA network.

## b) Micro-site Level

The desired ecological condition for the micro-site level of unique habitats and species would be to maintain or enhance areas of exceptional aesthetic value, unique wildlife or plant habitat or that contribute needed components for biological diversity (WNF LRMP IV-104, 1990). These unique habitats and species are further described below, including: riparian reserves; non-forested communities; forested groups; survey and manage and protection and buffer species; and other unique species.

## (1) Riparian Reserves

## (a) Aquatic and Terrestrial Habitat

The desired ecological condition for riparian vegetation is to maintain the hydrologic, geomorphic, and ecological process to benefit fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular

## (a) Unique Forest Groups

The DEC for unique forest groups will be to perpetuate, restore and maintain habitats over time, to highlight these habitats in management actions, and to tie to connectivity for TES, S&M, P&B, and MIS species. During project analysis and management activities, locate these unique habitats on a site-specific basis. Apply appropriate standards and guidelines as noted

## (b) Snags And Downed Log

The NWFP recognizes the need for snags, logs and green tree recruitment to be provided within LSR's and MLSA's. It notes that late successional and old growth characteristics are needed to provide overtime in forested communities the following:

1. Multiple species, multi-layer trees;
2. Moderate to high accumulations of large logs and snags;
3. Moderate to high numbers of trees with physical imperfections, cavities, broken tops, large deformed limbs;
4. Moderate to high accumulations of fungi, lichen and bryophytes. (NWFP, page 3-5, 1994).

The Desired Ecological Conditions for forest vegetation types, soils, wildlife, fish, fire regime, and other resource values within LSR's/MLSA's is displayed for snags, downed logs, and green tree recruitment in Table 17, which summarizes these levels. These levels are based on the following references: ROD, Region 6 Old Growth Definitions (USDA Forest Service 1993a), Wenatchee NF snag direction (USDA Forest Service 1995b), Leavenworth burned black snag paper (USDA Forest Service 1995c), Ecological Plot data for the Wet Forest Series, Pre-fire and Post-fire conditions (Everett 1995), Wenatchee National Forest Wildlife biologist team paper (1994), MIS species and management in the Forest Plan (USDA Forest Service 1990).

In areas currently with green tree recruitment, the Wenatchee National Forest snag direction (USDA Forest Service 1995b) will be used. In areas that are devoid of green tree recruitment, the Leavenworth RD snag recommendations (USDA Forest Service 1995c) will be used. For LSR goals, the high end of the ranges will be used in tree removal areas. MLSAs will use moderate to high end of the ranges. The goal will be to perpetuate, restore, maintain habitats over time, to highlight these habitats in management actions, and to tie to connectivity for TES, S&M, P&B, and MIS species. During project analysis and management activities, locate these unique habitats on a site-specific basis. Apply appropriate standards and guidelines as noted

The determination of DEC's for snags, logs and green tree recruitment also included a review of literature citations of wildlife uses of these forest structures. The snag/log/green tree levels, sizes, species and decay stages will meet the needs of species dependant on snags and woody debris. (see "Wildlife Use of Snags/Downed Logs/Green Tree Recruitment" in table 17). LSRs and MLSAs provide long term and short term snags and downed logs habitat to support the following wildlife species and their prey bases: northern spotted owl, black-backed woodpecker, northern three-toed woodpecker, flammulated owl, pygmy nuthatch, white-headed woodpecker, great gray owl, lynx denning, marten, goshawk, white-headed woodpecker, several bat species, and tailed frogs

Several lichen and fungi species (some of which are survey and manage species) are tied to the downed logs and snags. Snags of various stages of decay supply habitat and refugia for both lichens and fungi. Subsequent colonization (and in the case of fungi, metabolism and deterioration) of these substrates enable use by other organisms. The moist downed logs act as a water reservoir, holding water well into summer droughts.

**Table 17, Wenatchee National Forest LSR Snag/Downed Log/Green Tree Recruitment Levels:**

Forest Veg Group	Snag DBH Class	Areas With - Green Tree Recruitment	-Downed Logs & CWD	Areas of -No Green Recruitment	-Downed Logs & CWD
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**Dry, Mesic Mixed, Moist and Subalpine Fir** Forest Group snag and log levels were based on the WNF 5/24/95 "2600 Wildlife tree direction", and Leavenworth Ranger District 1995 "Leavenworth snag management for areas with no snag recruitment in the fire areas."

**Riparian** Forest Group snag and log levels were based on high end ranges for the vegetative types.

All levels are substantiated by the WNF LRMP 1990, Shellhaus, Everett et al (unpublished data), and the WNF LSR Snag, Green Tree Recruitment and Downed Log Analysis, specifically Table 17 "Wildlife Use of Snags/Downed Logs/Green Tree Recruitment."

#### (4) Survey and Manage Species and Protection and Buffer Species

The DEC for Survey and Manage Species and Protection and Buffer Species and habitats will be to perpetuate, restore and maintain habitats over time, to highlight these habitats in management actions, and to tie to connectivity for TES, S&M, P&B, and MIS species. During project analysis and management activities, locate these unique habitats on a site-specific basis. Apply appropriate standards and guidelines as noted. Species benefitting will be flammulated owls, black-backed woodpecker, pygmy nuthatch, white-headed woodpecker, 6 bat species, lynx, mollusks, amphibians, vascular plants, fungi, lichen, bryophytes, and the species listed below.

The unmapped LSRs and unmapped MLSAs will function within Matrix and AMA for the species and habitats to provide biological concerns of species closely related to late successional forests. These species include spotted owl, marbled murrelet, great gray owl, Larch Mountain salamander, 6 fungi and 3 mosses.

#### (5) Other Unique Species

Other unique species are made up of all **PETS plant and animal** species. (See sections above for species, habitat, LSR/MLSA descriptions and DEC). See wildlife and plants species list for individual LSRs/MLSAs.

Also included are the **Management Indicator Species** (MIS) from the Wenatchee NF LRMP, there are 16 species (see "Unique habitat and species module"). MIS are selected species representative of habitat types, such as beaver for riparian and mountain goat for cliffs (see WNF LRMP 1990 pages IV 26, 80-84 for descriptions and DEC).

Additionally, special emphasis will be applied to raptors, raptor nests, colonial bird nests, boreal owl nests, neotropical migratory birds, and all bird nests, which are protected under the Migratory Bird Treaty Act. Nest sites will be protected.

Unique species and habitats also include plants and animals used by American Indians for traditional uses (see Appendix 25). American Indian Sites, such as vision quests or pictographs are included in this section. These sites will be protected and access for American Indian uses will be provided through the Travel and Access

#### c) Survey and Manage Species

The DEC for Survey and Manage Species and habitats will be to perpetuate, restore and maintain habitats over time, to highlight these habitats in management actions, and to tie to connectivity for TES, S&M, P&B, and MIS species. During project analysis and management activities, locate these unique habitats on a site-specific basis. Apply appropriate standards and guidelines as noted

#### d) Protection and Buffer Species

The DEC for Protection and Buffer Species and habitats will be to perpetuate, restore, maintain habitats over time, to highlight these habitats in management actions, and to tie to connectivity

variability (see Vegetative Landscape section). In other words, continuous canopy and high density in the dry forest vegetation group is contiguous or in close proximity to that of more cool and moist forest groups such as the moist grand fir, wet, and subalpine fir groups. Since the dry forest is inherently at high risk or ignition, the risk of ignition in the more cool and moist types is increased. The sustainability of current vegetation within a particular LSR or MLSA over the next 20 year period is greatly influenced by fuel hazard and risk.

The Vegetation Hazard and Ignition Risk Ratings table following this discussion shows the amount and percent of vegetation at risk and the amount and percent of late successional forest at risk for each LSR/MLSA on the forest. The higher the percent for each of the two categories listed, the lower the sustainability of the current vegetative conditions in the LSR.

Note: Another aspect of sustainability is insect and disease. The susceptibility of vegetation to both of these can also affect sustainability. There is a direct correlation between vegetation susceptible to fire and vegetation susceptible to insects and disease and the same vegetative types are at risk. This same analysis can be applied for insects and disease. (see "Landscape Susceptibility to Insect and Disease", table 10, in the Disturbance Chapter.)

The second factor besides vegetative condition is the actual risk of fire ignition within or adjacent to the LSR/MLSA. This has been estimated by analyzing which Fire Management Analysis Zone (FMAZ) that is most typical of the LSR. There are 5 FMAZ's on the Wenatchee. FMAZ 1 has a high risk of fire ignition, FMAZ 2-4 have moderate risks of fire ignition and FMAZ 5 has a low fire ignition risk. The actual number representing the risk of ignition come from an analysis of fire starts on the forest from 1979 to 1988 totaling 1200 ignitions.

**Table 18, FMAZ Ignitions per 1000 Acres per Year for Each FEMAZ**

<b>FMAZ</b>	<b>Ignitions/1000ac/yr</b>
1	0.102
2	0.074
3	0.046
4	0.044
5	0.030

The Vegetation Hazard and Ignition Risk Ratings table shows ignition risk category for each LSR/MLSA according to the predominant FMAZ zone associated with the LSR or MLSA in the far right column.

Because there is not a significant difference in the risk of ignition across the whole range of Fire Management Analysis Zones (Approximately a three fold increase from FMAZ 1 to FMAZ 5), the vegetative hazard analysis is given more importance in determining overall sustainability.

It is impossible to quantify just how likely an LSR or MLSA is to burn in a given time period. We do know that the Dry Forest vegetation group historically experienced landscape level fire every 7 to 14 years on the Wenatchee (Everett, Schellhaas in publication). In the last 50 to 70 years fire suppression efforts have been largely successful at interrupting this fire frequency. It is this fire suppression that has for the most part resulted in the vegetation currently determined to be in a high hazard condition in this analysis. The landscape level stand replacement fires experienced on the forest in 1994, 1988, and 1970 are showing us that it is becoming increasingly difficult to control the scale and intensity of fires within and adjacent to the dry forest. All or significant portions of 5 LSR's were burned in 1994 alone. The degree to which high hazard vegetation is present as determined by this analysis represents the best estimate of the overall sustainability of the LSR or MLSA.

has 7 (1 on private) of the 33 sites below threshold. There is only 1 dry owl site, making this highly sustainable for spotted owls. Due to the checker-board ownership in this LSR, there are concerns for long-term sustainability, because of potential fragmentation.

The Swauk has 23 pairs of owls, 1 single, but sustainability of that habitat over time is of concern. This LSR has 22 of the 24 sites below threshold, the other 2 sites are at threshold. There are 18 dry owl sites, making this a sustainability risk for long-term spotted owl viability.

The Chiwawa has 13 pairs of owls, 1 single, and 3 sites burned during the Tyee Fire of 1994, there is great potential to restore sustainable habitat in the wetter forest groups for long-term population viability. This LSR has 13 of the 17 sites below threshold, the other 4 sites are at or above threshold. There are 10 dry owl sites, making this a partial risk for long term sustainability in the dry forests, if the wetter forests are not allowed to recover. Overtime, it is expected that higher quality and more sustainable habitat will be restored to the western portion of this LSR.

The three large LSR's currently have spotted owl habitat at the following levels, Manastash 65% (68,147 acres) with potential for 67%; Swauk 42% (45,675 acres) with potential for 68%, and Chiwawa 46% (49,489 acres) with potential for 76%.

#### b) Home Ranges Within LSR's

Home ranges in the large LSR's, as well as the smaller ones and MLSA's vary depending on placement of natural and manmade openings. There are 60 of the 156 owl sites below threshold on Forest LSR's and MLSA's (see Appendix 14).

Spotted owl activity centers were mapped for each of the 230 spotted owl sites (residential single, pair or reproductive pair) on the Forest. This includes 100 acres of the best quality habitat for nesting or breeding for all activity centers (NWFP C-10, 1994). Mapped LSR's and MLSA's have a 500 acre core area within 0.7 miles radius, which includes nesting/roosting/foraging habitat used during the breeding season.

The year-round home range for each owl pair is much larger during the winter months, when prey availability is lowest, and thermal cover is critical. The current mean home range for spotted owls on the Wenatchee is 6,657 acres of habitat, within 1.8 miles radius, this is for the eastern Cascade province (NWFP A-3, Appendix B-77 to 80, USDI NSO Recovery Plan page 23 199\_, Bart and Forsman 1992). To increase spotted owl populations over time, optimal habitat is 60% of the home range, or 3,944 acres. The goals for LSR's is to reach 60% for each owl site. There are some exceptions on drier sites that are not sustainable and are currently below those figures. A GIS analysis based on habitat modeling shows the drier owl sites average 2,345 acres (35%). To sustain an owl population, the habitat amount needed is 40% of the home range, or 2,663 acres. This 40% amount is the "Take Threshold" for an owl population. The goal for MLSA's is to maintain owl home ranges above 40% for each owl site. See Appendix 14 and Individual LSR/MLSA chapters for more information on status of Wenatchee Forest owls.

The home range size for spotted owls in the Eastern Cascades province is tied to the mean for Washington State, which is 6,657 acres, 1.8 miles radius. This is due to the past lack of radio telemetried spotted owl pairs in the eastern Cascades. It has long been hypothesized that in drier forests, spotted owls may use different home ranges. The NWFP appendix B page 77 recommends using data from spotted owl study areas most similar to the sites concerned. This LSR/MLSA Assessment included an analysis, which separated wetter owl sites (wet, moist, high elevation forests) and drier owl sites (dry and mesic forests). Current research on drier forests is underway in the eastern Cascades. There are 5 radio telemetried spotted owl pairs on the Wenatchee, studied by the Forest Science Lab in Olympia. There are an additional 6 radio telemetried spotted owl pairs on the Yakama Indian Reservation, studied by tribal biologists. If the results of these studies show different home range sizes, they can be applied to Wenatchee spotted owl sites.

LSR or MLSA	Dry Owls <sup>3</sup>			Wet Owls <sup>3</sup>		
	Below Threshold <sup>4</sup>	At Threshold <sup>5</sup>	Optimum <sup>6</sup>	Below Threshold <sup>4</sup>	At Threshold <sup>5</sup>	Optimum <sup>6</sup>
Chiwawa		SO633				
Chiwawa	SO634					
Chiwawa				SO638		
Chiwawa				SO645		
Chiwawa				SO649		
Chiwawa	SO708					
Chiwawa	SO714					
Chiwawa	SO731					
Chiwawa	SO749					
Deadhorse					SO703	
Deadhorse	SO715					
Deadhorse	SO720					
Deadhorse <sup>1</sup>	SO721					
Deadhorse	SO725					
Deadhorse	SO726					
Deadhorse	SO727					
Deadhorse	SO744					
Deadhorse	SO762					
Icicle						SO734
Icicle					SO747	
Little Wenatchee				SO602		
Little Wenatchee					SO603	
Little Wenatchee					SO614	
Little Wenatchee					SO624	
Little Wenatchee						SO631
Little Wenatchee					SO632	
Little Wenatchee						SO648
Little Wenatchee						SO653
Little Wenatchee					SO654	
Lucerne <sup>1</sup>		SO201				
Manastash					SO305	
Manastash				SO311		
Manastash					SO321	
Manastash				SO326		
Manastash						SO327
Manastash						SO332
Manastash					SO338	
Manastash						SO343
Manastash				SO349		
Manastash					SO351	
Manastash	SO353					
Manastash						SO357
Manastash						SO358
Manastash				SO362		
Manastash					SO364	
Manastash				SO365		
Manastash					SO368	

LSR or MLSA	Dry Owls <sup>3</sup>			Wet Owls <sup>3</sup>		
	Below Threshold <sup>4</sup>	At Threshold <sup>5</sup>	Optimum <sup>6</sup>	Below Threshold <sup>4</sup>	At Threshold <sup>5</sup>	Optimum <sup>6</sup>
Teanaway				SO306		
Teanaway					SO319	
Teanaway	SO344					
Teanaway		SO356				
Teanaway				SO381		
Tieton <sup>1</sup>					SO800	
Tieton						SO802
Tieton						SO809
Tieton					SO812	
Tieton					SO819	
Tieton					SO828	
Tieton					SO835	
Tieton						SO837
Tieton		SO841				
Tieton						SO855
Tieton						SO870
Tieton					SO882	
Tieton <sup>1</sup>					SO888	
Upper Nile <sup>2</sup>					SO814	
Upper Nile						SO862
Upper Nile					SO863	
Crow						SO805
Crow						SO824
Crow					SO854	
Crow					SO874	
Crow						SO886
Eagle				SO748		
Haystack	SO806					
Haystack <sup>2</sup>					SO814	
Haystack	SO846					
Haystack					SO866	
Haystack	SO868					
Haystack	SO879					
Haystack	SO883					
Haystack	SO890					
Lost Lake					SO807	
Milk Creek					SO838	
Milk Creek				SO840		
Milk Creek					SO865	
Russell Ridge				SO831		
Russell Ridge	SO864					
Sand Creek	SO729					
Sand Creek	SO753					
Sand Creek	SO758					
Tumwater	SO722					
Twin Lakes				SO611		

<sup>1</sup> Near the LSR or MLSA but not inside the LSR or MLSA.

dry forest group is currently high density, low vigor, while only 22 percent is low density, including park-like stands. There is greater than 65 percent layered (dominant overstory and well-developed understory) habitat present in the moist grand fir/mesic hemlock and wet forest groups. The subalpine fir series consists of approximately 70 percent layered habitat within LSR's and MLSA's throughout the forest.

As mentioned earlier, some species, particularly those listed in FEMAT or rare species, occupy habitats earlier in a particular sere in addition to late-successional habitat. For such species, it may more appropriate to discuss the availability of "suitable" habitat rather than late-successional habitat alone. For example, *Iliamna longisepala* apparently responds vigorously to fire (Kuhlmann and Harrod unpubl. report) and is most abundant in recently (10 years or less) burned areas within the dry forest group (R.J. Harrod, personal observation). Early-successional habitats are the most "suitable" habitat for *I. longisepala*. Such distinctions will be addressed throughout the document.

#### b) Effectiveness of Late-Successional or Suitable Habitat

A description of habitat effectiveness is typically used in land management to describe habitats for wildlife species. However, the concept has merit for describing "effectiveness" of habitat for vascular plant species. Effectiveness here is defined as the ability of the available habitat to provide for individual species requirements without disturbance, human or "natural" caused. Habitats have low effectiveness for vascular plants in the following examples.

Many plant species require biotic vectors to carry out pollination and the loss of such organisms could reduce or eliminate the ability to reproduce. Habitats may be providing all requirements for a particular species, but if required pollinators are reduced or eliminated the effectiveness of the habitat is greatly lowered.

Habitat effectiveness can be lowered with human activities such as off-road vehicle use, collecting, and excessive dust and salt from roads. These activities are most pronounced for species with limited or disjunct distributions.

### 3. Forest-Wide Vascular Plant Connectivity

The following table presents the results of the connectivity analysis applied to the Wenatchee LSR's and MLSA's

Table 22, Forest-Wide Vascular Plant Connectivity

	Vegetation Group														
LSR/MLSA	Dry/Mesic			Moist GF			Subalpine			Wet			Whitebark		
Dispersal Class	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Sawtooth	N	D	Y	A	A	A	N	D	Y	N	N	Y	N	N	Y
Lucerne	Y	Y	Y	A	A	A	N	D	D	N	D	D	A	A	A
Shady Pass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Slide Peak	D	D	Y	A	A	A	D	D	D	A	A	A	A	A	A
Chiwawa	Y	Y	Y	N	N	Y	D	Y	Y	D	Y	Y	N	N	N
DM-1	A	A	A	D	Y	Y	A	A	A	Y	Y	Y			
Little Wenatchee	A	A	A	A	A	A	N	N	N	Y	Y	Y			
DM-2	D	D	D	D	D	Y	A	A	A	A	A	A			
Deadhorse	D	D	D	D	D	Y	A	A	A	N	D	D			
DM-5	D	D	D	N	D	D	A	A	A	A	A	A			

## b) Sustainability

To this point, habitat availability, connectivity, and effectiveness has dealt with current conditions within LSR's or MLSA's describing spatial aspects of the network function. Temporal considerations are also important since ecosystems are in a constant state of flux (Harrod et al. 1996a). Habitats may currently be abundantly available and effective for vascular plant species listed in Appendix 6, but whether or not habitats can be sustained for long periods of time is an important consideration.

Many habitats within the dry forest group are currently not sustainable because of increased fire and insect and disease risk associated with nearly a century of fire exclusion. The same is likely true for the moist grand fir/mesic hemlock forest group in many cases where the dry forest group occurs adjacently. The more cool and moist subalpine fir series and the wet forest group are likely more sustainable than the drier and warmer forest groups. However, the whitebark pine/subalpine larch forest group is more similar to the dry forest group because fire was historically more frequent than in the subalpine fir or mountain hemlock series.

Suitable habitats for rare or survey and manage species need to be sustained across the landscape, particularly within LSR's or MLSA's. For some species, suitable habitat may shift across the landscape over time as long as availability of habitat remains adequate to address species viability. Other species, such as *Delphinium viridescens*, have specific habitat requirements for habitats that are not readily spatially or temporally mobile across the landscape. In any case, sustainability of habitat for species with special status will be of utmost importance within LSR's or MLSA's throughout the Wenatchee National Forest.

## 4. Function Of The Network For Lichen Species

This section will provide an assessment of the function of the forest-wide LSR and MLSA network for lichen species on the Wenatchee National Forest. As with vascular plant species; the availability, effectiveness, and connectivity of habitat is necessary for maintenance of viable populations of lichens associated with late-successional ecosystems. The sustainability of late-successional ecosystems is an important component in assessing the long-term viability of lichen populations. The sustainability of the respective forest vegetation groups is addressed elsewhere in this document.

### a) Availability Of Late-Successional Habitat

The relationship between late-successional habitat and lichen occurrence is well documented in the literature. Late-successional ecosystems perform several ecological functions that appear to be absent, or less developed, in younger forest ecosystems. Late-successional forest communities are the result of a unique interaction of disturbance, regeneration, succession, and climate. Environmental factors most likely controlling the distribution of lichens in these stands include: light, humidity, lack of climatic variation, quality and quantity of large woody debris, and long-term continuity of woody vegetation (Lesica, McCune, Cooper, and Hong 1990). Many of these factors are a function of the stand structure provided by late-successional ecosystems. As forest succession occurs, an associated pattern of lichen establishment occurs which is represented by changes in species composition and an increase in lichen diversity and abundance (FEMAT 1993). Some lichen species become established only after the forest community has matured and provided the appropriate substrates and associated microclimates. It's not unlikely that 200 or more years may pass before the late-successional lichens become established in these communities (Lesica et al. 1991; McCune 1991; Henderson et al. 1988). Due to this successional pathway and the relatively slow growth rates of lichens, the persistence of substrate and maintenance of microclimate are key factors in maintenance of viable lichen populations.

30 cm specimen of a giant puffball may have 7 trillion spores...if all 7 trillion spores (at 1/200 mm size) were lined up in a row, they would circle the earth's equator!". Theoretically all the spores would be capable of germinating and obviously do not, underscoring the often very exacting environmental conditions necessary for successful germination.

Species of fungi which rely on wind disseminated spores (most of the above ground macrofungi on the ROD list) may not have a problem dispersing to sites located a distance away (e.g. whitebark pine, subalpine larch habitats on distant ridges) but are still reliant on timing and conducive conditions necessary for successful colonization. The hypogeous fungi can be very localized and dependent on the animal vector populations (usually rodents) for their continued success (Maser et al. 1978). The scuffing of the ground by larger animals may also expose these sporocarps and help dispersal. Mycophagy by deer and other large mammals can disseminate spores of those fungi over varying distances. In addition, any number of other processes may spread or maintain the fungus species. The typical outward growth of mycelium in the rhizosphere can maintain the persistence and spread of a species for over 400 years and over a distance of miles (Alexopoulos and Mims 1979). Some species may be present as dormant or relatively inactive structures for many years in the rhizosphere awaiting liberation with sudden spontaneous conducive environmental conditions as may be the case with some Ascomycete species (Nancy Weber, pers. comm.). All told, for some species, adjacent habitat may be essential for viability; for others, it may not be as critical. Surveys within the LSR's are necessary to determine which species are present and project their connectivity needs.

#### d) Sustainability

The issue of sustainability for fungal species mirrors that for vascular plants. The Vegetation Groups probably have a unique fungal complement as well as fungal guilds shared with other Groups. The Vegetation Groups historically experiencing fire on a more frequent basis may not be sustainable into the future without management intervention. Their passing may also include extirpation of fungal species directly associated with them but also may not affect other species with broad host or environmental ranges. The current distribution of all fungus species is poorly known. We do not know where all populations of species occur, the specifics of their habitat requirements, interactions among species, and the successional role of fungus species in different species or habitats (J2, FEIS 1994). J2 also recommends that in addition to protection of sites for individual species, areas that support a diversity of species and concentration of rare and/or endemic fungi could be established as Special Interest Areas or Areas of Critical Environmental Concern to identify mycological resource value of the site.

### 6. Function Of The Network for Wildlife

The overall function of the LSR/MLSA network was evaluated based upon the following factors: the availability of late successional habitats, the effectiveness of these habitats relative to human activities, the connectivity between late-successional habitat patches, and the sustainability of these habitats over time. The function of any individual LSR/MLSA is addressed within the chapter that is specific to each.

#### a) Availability of Late-Successional Habitats

The availability of late-successional habitats for wildlife within LSR/MLSA's has been significantly affected by a variety of past management activities and large scale disturbances such as wildfires.

#### b) Effectiveness of Late-Successional Habitats

Currently, 8 (30%) of the LSR/MLSAs evaluated have a open road habitat effectiveness level of high, 7 (26%) as moderate, and 12 (44%) as low. Currently, the level of security habitat effectiveness was high in 3 (11%) LSR/MLSA's, moderate in 5 (19%) LSR/MLSAs, and low in 19 (70%) LSR/MLSAs.

and identify areas where the risk of unnaturally high fire intensity can be reduced and still maintain the viability of spotted owl activity centers.

## 7. Function Of The Network for Unique Habitats and Species

The overall function of the LSR/MLSA network for unique habitats and species was evaluated based on the following factors: abundance and ecological diversity; providing connectivity for unique habitats; and the process and function of the habitats and ecosystems. Overall, three LSR's met high quality for unique habitat in each evaluation, they were Little Wenatchee, Chiwawa, Tieton and Swauk. Other high ranking LSR/MLSAs included Manastash, Shady Pass, Teanaway, Icicle, Bumping LSR's and, Crow MLSA. The individual LSR/MLSAs are discussed within the chapter specific to each.

### a) Abundance and Ecological Diversity

The LSR/MLSA network was analyzed for high amounts of acreage and wide variety of plant communities and environments. This analysis included: acreage for unique plant and animal habitats; juxtaposition of habitats; availability of wilderness or areas of rarity, and known observations from the plant and animal species lists.

**Table 23, Unique Habitats and Species Abundance** (Comparative ranking)

High Quality	Moderate Quality	Lower Quality
Little Wenatchee LSR	Milk MLSA	Sawtooth LSR
Chiwawa LSR	Bumping LSR	Lucerne LSR
Manastash LSR	Twin MLSA	Sand Cr. MLSA
Tieton LSR	Icicle LSR	Russell Ridge MLSA
Shady Pass	Haystack MLSA	Camas MLSA
Swauk LSR	Lost Lake MLSA	Deadhorse LSR
	Upper Nile LSR	Boundary Butte LSR
	Tumwater MLSA	Rattlesnake LSR
		Natapoc MLSA
		Eagle MLSA
		Slide Peak LSR

### b) Providing Connectivity for Unique Habitats

This analysis looks at if the LSR/MLSA provides connectivity in a landscape pattern for biological flow to sustain unique animal and plant communities. Included in this was the amount, percent and patch numbers of late successional habitat, forest interior habitats and the juxtaposition of wilderness and areas of rarity.

**Table 24, Connectivity for Unique Habitats and Species** (Comparative ranking)

High Quality	Moderate Quality	Lower Quality
Manastash LSR	Icicle LSR	Twin Lakes MLSA
Chiwawa LSR	Teanaway LSR	Russell Ridge MLSA
Tieton LSR	Upper Nile LSR	Boundary Butte LSR
Shady Pass LSR	Tumwater MLSA	Haystack MLSA
Little Wenatchee LSR	Milk MLSA	Deadhorse LSR
Crow MLSA	Lucerne LSR	Lost Lake MLSA
Swauk LSR	Rattlesnake LSR	Sand Cr. MLSA
Bumping LSR		Sawtooth LSR

There is potential quality and quantity decline and concern for snags, downed loges and future green tree recruitment in the following LSR/MLSA's: Haystack; Milk MLSA's and Swauk LSR.

**Table 26, Unique Habitats and Species by LSR/MLSA**

Unique Habitat or Species	Sawtooth	Lucerne	Shady Pass	Slide Peak	Chiwawa	Little Wenatchee	Deadhorse	Icicle
Riparian Reserves (acres)	1514	1007	6832	75	14,074	7312	1684	1820
%	10%	12%	9%	5%	13%	14%	9%	13%
Water (acres)	30	272	60		700	54	170	1
%	TR	3%	TR		1%	TR	1%	TR
Wet meadows (acres)	125	72	448		243	1073	22	
%	<1%	<1%	<1%		TR	2%	TR	
Subalpine Meadows (acres)	1554	106	2059		966	222		454
%	10%	1%	2%		1%	<1%		3%
Dry Meadows (acres)							8	
%							TR	
Grass/Shrub/Natural Open	0	191	315	0	193	32	393	0
%		2%	<1%		TR	TR	2%	
Shrub/Brush Fields (acres)	78	124	1337		1203	4931	209	453
%	<1%	1%	1%		1%	9%	1%	3%
Deciduous Trees (acres)		105					62	
%		1%					<1%	
Whitebark Pine/SubLarch	8213	144	8363	0	1893	147	413	0
%	54%	2%	11%		2%	TR	3%	
Pac. Yew/Al. Yellow Cedar	0	0%	0	0	PY	PY,ALC	0	PY,ALC
Talus	728		1552		877	91	213	314
%	5%		2%		1%	<1%	1%	2%
Rock	85		718		85	302		580
%	<1%		1%		TR	<1%		4%
Cliff	160		3075		328	138	86	264
%	1%		4%		<1%	<1%	<1%	2%
Late Succ Hab Moi/Hi %	19%	9%	49%	0%	42%	56%	8%	52%
Forest Interior Dry (acres)	39	1703	3722	unknown	2335	0	298	26
# of Patches	1	3	13		21		6	1
Forest Interior High	856	0	13766	unknown	4121	177	0	32
# of Patches	6		23		21	3		1
Forest Interior Wet	0	0	5170	unknown	6632	3558	0	2144
# of Patches			13		27	30		7
Snag/Log/GTR Quality			M-H		M			
WL Spp Spec Status & LS	18spp	15spp	29spp	19spp	61spp	56spp	25spp	40spp
WL PETS Spp	4	4	10	3	13	15	7	11
WL S&M + P&B Spp	0	0	3	2	5	1	2	0
MIS Spp	6	7	11	5	12	12	9	13
Plant Spp Spec Stat & LS	1spp	0	24	8	70	71	25	35
Plant Spp PETS + S&M	1	0	2	0	30	27	9	3
Wilderness	CSW	GPW	GPW	0	GPW	GP,HMJ,ALW	0	ALW
Rare Areas	0	RAP	RP	0	RAP,BO T	RAP,RNA	RP	RAP

Unique Habitat or Species	Boundary	Swauk	Teanaway	Manastash	Bumping	Upper Nile	Rattle-snake	Tieton
Riparian Reserves (acres)	482	12,678	3941	14,513	3947	1108	1223	6208
%	6%	12%	12%	14%	26%	12%	12%	16%
Water (acres)		11		60	1375		3	68

Unique Habitat or Species	Camas	Crow	Eagle	Haystack	Lost Lake	Milk Creek	Natapoc	Russell
%	5%	<1%	5%	2%	3%	TR		2%
Shrub/Brush Fields (acres)	10							10
%	1%							TR
Deciduous Trees (acres)		12		141	100	60		10
%		<1%		1%	1%	<1%		TR
Whitebark Pine/SubLarch	0	0	0	0%	0%	0	0	0
%								
Pac. Yew/Al. Yellow Cedar	0	PY, ALC	0	0%	AYC	0	AYC	0
Talus		632		964	321	1073		559
%		5%		4%	5%	7%		5%
Rock (acres)		545	7	1094	469	14		534
%		4%	TR	4%	7%	TR		4%
Cliff (acres)			2	4	22		6	71
%			TR	TR	<1%		<1%	<1%
Late Succ Hab Moi/Hi %	0%	77%	20%	21%	25%	54%	5%	32%
Forest Interior Dry (acres)	279	0	35	2146	756	0	73	725
# of Patches	2		1	11	2		1	5
Forest Interior High (acres)	0	0	0	0	0	0	0	137
# of Patches								3
Forest Interior Wet (acres)	0	3486	189	584	28	1489	0	373
# of Patches		10	2	8	1	13		5
Snag/Log/GTR Quality				L		L		
WL Spp Spec Status & LS	13spp	32spp	19spp	41spp	26spp	42spp	27spp	23spp
WL PETS Spp	2	6	4	7	6	12	3	5
WL S&M + P&B Spp	1	1	1	3	0	3	1	2
MIS Spp	5	11	7	12	9	12	8	6
Plant Spp Spec Stat & LS	19	33	16	26	28	28	19	29
Plant Spp PETS + S&M	5	4	1	2	2	2	6	2
Wilderness	0	NP, WODW	0	WODW	0	0	0	WODW
Rare Areas	RP	0	RP	0	GEO	0	RP	RA

Unique Habitat or Species	Sand Cr.	Tumwater	Twin Lk
Riparian Reserves (acres)	862	326	183
%	9%	8%	3%
Water (acres)		115	298
%		3%	5%
Wet meadows (acres)			
%			
Subalpine Meadows (acres)	8	9	10
%	<1%	<1%	<1%
Dry Meadows (acres)			
%			
Grass/Shrub/Natural Open	484	14	64
%	5%	<1%	1%
Shrub/Brush Fields (acres)	33	111	344
%	<1%	3%	6%
Deciduous Trees (acres)			
%			
Whitebark Pine/SubLarch	0		0
%		TR	

There is potential quality and quantity decline and concern for snags, downed logs and future green tree recruitment in the following LSR/MLSA's: Haystack; Milk MLSA's and Swauk LSR.:

## **G. Fire Management Plan**

Developing a Fire Management Plan for the Late Successional Reserve (LSR) System located on the Wenatchee National Forest must involve the integration of our knowledge of the fire planning efforts for the adjacent lands, the vegetative conditions desired by the resource specialists, and the disturbance events, or lack thereof, which have shaped the forests which we inherit today. This plan provides an overview of the entire forest, more specific direction is included in the individual LSR/MLSA chapters.

For the lands included in the late successional reserves the maintenance of these late successional vegetative characteristics must be viewed as the preeminent management objective as these lands have been reserved for this purpose. The protection of this vegetation as an important attribute of the entire Wenatchee National Forest must be considered in this planning process. Other uses must be considered subordinate and management practices and prescriptions should reflect this.

The fire management question then becomes, how should this be done? The debate of today centers not around the need to suppress resource or amenity destroying fires but rather on how to manage the disturbance processes necessary to sustain these forests over decades on the landscape scale. The portion of this plan which discusses the disturbance regimes and agents accurately outlines the changes that have occurred, and the conditions which have resulted. It is the purpose of this planning effort to outline the actions which are deemed necessary to provide the best probability of retaining these late successional attributes.

The Fire Management program is made up of several elements. Fire Prevention, Fire Detection, Wildfire Suppression, Vegetation Management, and the use of Prescribed Fire as a management tool are all necessary components. The following discussion will outline actions needed throughout the LSR and MLSA network. It is intended to be supplemented by site specific Fire Management plans for each geographical subdivision. The occurrence of wildfires in the LSR and MLSA network has been extracted from the data utilized in the National Fire Management Analysis System which is the planning process used to support the Land Management Planning Process for the remainder of the Wenatchee National Forest. The period of analysis was 1979 through 1988. As an appendix to this plan can be found an analysis of the number of ignitions and the acreage burned given the protection policies and actions taken during that period. From this data it can be seen that there is a stratification of risk of disturbance by wildfire which in turn can be an indication of the intensity and extent of management actions needed if the retention of some, or all, of the vegetative attributes are a management objective.

### **1. Wildfire Prevention**

The prevention of unwanted, human caused, wildfires for the LSR network must occur on two levels. First, management policies should be implemented to reduce the potential for ignitions within the boundaries of each LSR. An analysis should be completed which leads to the development of site specific prevention actions dependent on the risk of destructive wildfires. Actions such as Fire Prevention Signing, restriction on the use of spark emitting equipment, or restrictions on the use of campfires are examples of management actions which may be implemented. The second level of Fire Prevention which must be reviewed for each LSR is the opportunity to keep wildfires ignited outside the LSR from burning into these reserves. This could also be viewed as a "Preattack Plan", the intention of which would be to utilize topographic, or human created features to protect the attributes of the LSR from being destroyed by wildfire.

### **2. Fire Detection**

condition. Our attempts to minimize the extent of wildfires has resulted in vast changes in some ecosystems. If our management intentions are to bring these systems back towards the conditions found before Euro-American dominance then the application of prescribed fire can be a valuable management tool. Each application must be well planned and implemented only when the expected outcomes will benefit the entire LSR.

## 6. Summation

The fire management planning process for the LSR network must integrate all aspects of the fire management program. It must be driven by management's desire to establish a network of reserves with the attributes of late successional vegetation. There will be multiple DEC within this system which will require protection from unwanted wildfires and perhaps the application of prescribed fire when appropriate. Each LSR and MLSA will require the development of a site specific Fire management plan that addresses the elements outlined here. When completed these plans will be included in the Fire Management Action Plan for the Wenatchee National Forest.

## 7. LSR Expected Wildfire Ignitions and Acreage's Burned

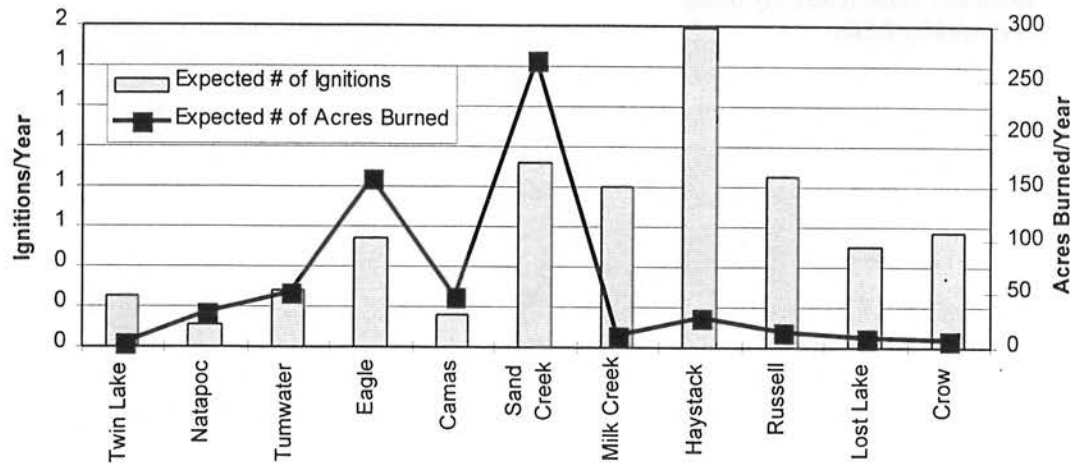
**Table 27, FMAZ Wildfire Ignitions Per Thousand Acres (1979-1988)**

Fire Management Analysis Zones (FMAZ)	Acres	Ignitions/1,000 ac./Year	Expected Burned Acres/Year
1	314,825	0.102	9379.83
2	256,725	0.074	353.03
3	699,104	0.044	387.15
4	346,519	0.046	199.79
5	516,008	0.03	185.91

**Table 28, LSR Wildfire Expected Ignitions and Acres Burned Summary**

(Individual LSR Calculations Included In Appendices)

LSR	Expected # of Ignitions/Year	Expected # of Acres Burned/ Year
Manashtash	4.87	66.62
Bumping	0.65	8.15
Upper Nile	0.42	5.30
Rattlesnake	0.63	10.23
Swauk	8.63	849.29
Teanaway	2.02	33.04
Boundary Butte	0.86	246.29
Icicle	0.74	79.90
Deadhorse	1.62	422.12
Lake Wenatchee	1.96	24.19
Chiwawa	5.71	619.78
Shady Pass	3.53	133.33
Slide Peak	0.17	49.34
Lucerne	0.68	158.47
Sawtooth	0.67	8.43
Tieton	1.98	27.19
<b>Total</b>	<b>35.15</b>	<b>2,741.66</b>



## H. Opportunities for Restoration and Maintenance

The general objectives of all treatments are to RESTORE, PROTECT or PROMOTE Late-Successional Habitat for the Northern Spotted Owl and other Late-Successional species in all LSR's/MLSA's. The target landscape, in terms of vegetation structure, composition and pattern, is defined for each forest vegetation group. This landscape defined by the DEC is assumed to be the best description of a sustainable landscape or ecosystem. Providing a sustainable level of Northern Spotted owl habitat will contribute toward maintaining the viability of the spotted owl within all LSR's/MLSA's and throughout the forest.

It is the intent and design of all treatments to be consistent with the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD) (1994), the Late-Successional Reserve Standards and Guidelines for National Forest Lands in the Eastern Washington Cascades and Yakima Provinces (1995) and the Wenatchee National Forest Land and Resource Management Plan (1990).

It is also the intent and design of all treatments to be consistent with watershed analysis "findings" and to meet the Aquatic Conservation Strategy Objectives of restoring and maintaining riparian ecosystems and natural disturbance/sediment regimes commensurate with the type of vegetation in the uplands. (ROD B9-B11, B20)

## I. Future LSR/MLSA Assessments

This document completes assessments for six LSR/MLSA's on the forest, the remaining 21 LSR/MLSA's will be completed in the fall/winter of 1996. This includes:

Camas MLSA	Bumping LSR
Deadhorse LSR	Crow MLSA
Icicle LSR	Eagle MLSA
Lost Lake MLSA	Little Wenatchee LSR
Manastash Ridge LSR	Lucerne LSR
Rattlesnake LSR	Natapoc MLSA
Sand Creek MLSA	Russell MLSA
Slide Peak LSR	Sawtooth LSR (to be completed by the Okanogan National Forest)
Tieton LSR	Teaway LSR
Twin Lake MLSA	Tumwater MLSA

## VIII. Chiwawa LSR

This individual chapter focuses on the Chiwawa LSR. The first section "A", provides a more specific description of unique resources or factors associated with this LSR than was presented in the general "forest-wide" chapters. Section "B" begins the analysis portion of this document assessing relationships between this LSR and neighboring LSR/MLSA's. Section "C" continues that analysis focusing on this individual LSR.

The subheadings in "B" and "C" follow the module sequence as shown on the "LSR Analysis Flow Chart" in Chapter VII and in Appendix A. A fire plan is also included at the end of Section "C" to provide more specific detail than that in the fire management plan included in the Chapter VII. Section D includes a table summarizing all of the projects identified from the analysis of each module completed in sections "B" and "C".

It is also important to note that the type of activities derived from these modules all strive to restore or maintain late successional habitat and species, as such these modules recommend "ecologically derived" projects. The social module, on the other hand, is designed to review projects that do not incorporate these restoration or maintenance objectives. The social module is designed to provide a "road map" to use when planning begins on a specific project that is derived from some social need such as building a new hiker or motorized trail, expanding a ski area, or widening a powerline right-of-way. Since the social module is not used to identify "ecologically derived" projects, the module is not included in this or any of the other individual LSR/MLSA chapters. The Assessment Team did complete a social module for the Three Creeks ORV Trail project on the Entiat Ranger District to validate the module. This module analysis is included in Appendix X.

The Lake Wenatchee Ranger District completed an Initial Assessment for the Chiwawa Late Successional Reserve (March 1996). This assessment covered the south half of the LSR, on three Ranger Districts (Lake Wenatchee, Leavenworth and Entiat). The Initial Assessment highlighted the Tyee fire recovery area, but was expanded out to include all of the southern portion of the LSR (52,500 acres) and the adjacent lands, altogether covering 85,000 acres. The Initial Assessment is incorporated into this chapter by reference. There are several items that have been added or changed, between the Initial and this Chiwawa LSR assessment. The following are highlights of those additions and changes:

### **Forest-wide Overview**

As a result of analyzing all LSR's and MLSA's across the Wenatchee National Forest, a comparison of the Chiwawa LSR's values, importance, risk, juxtaposition, and connectivity is more thoroughly understood and displayed. This landscape level approach, provides a perspective for late-successional species and habitats.

### **Complete Chiwawa LSR is Analyzed**

The whole Chiwawa LSR is 107,000 acres, and is covered in this assessment, which encompasses the north half of the LSR. This LSR, now includes the portion of the Chiwawa watershed from Grouse Creek northwest to Phelps Creek, which is all on the Lake Wenatchee Ranger District.

### **Vegetation Modeled**

To be consistent across the Forest, models were used to assess vegetation, unless aerial photo interpretation was completed prior to this process. The south portion of the Chiwawa LSR was photo interpreted, based on Forest-wide process. The north half of the Chiwawa LSR vegetation was modeled. Prior to future watershed assessments or project level planning, this vegetation layer needs to be field verified and altered as needed.

This vegetation layer was the baseline for developing other models, such as: Risk Assessment/Susceptibility Matrix; Desired Ecological Conditions; Suitable Spotted Owl Habitat

establishment. Western white pine (*Pinus monticola*) and western larch may also be present. The understory tends to be more lush and often with a higher shrub component than in the more dry plant associations within the Douglas-fir and ponderosa series. Understory shrub species include tall shrubs such as *Symphoricarpos abulus*, *Holodiscus discolor*, *Spiraea betulifolia*, and *Rosa* spp., and *Arctostaphylos uva-ursi*, *Berberis nervosa* and *Pachistima myrsinites* as low shrubs (Chiwawa Initial LSR Assessment). Herb composition may include *Festuca occidentalis*, *Carex geyeri*, *Calamagrostis rubescens*, *Smilacina stellata*, and *Claytonia lanceolata*.

#### c) Moist Grand Fir Group

Seventeen percent (18,724 acres) of the Chiwawa LSR consists of the moist grand fir group. About half (45%) of this forest group is currently layered and/or mature (mid- to late-successional) (appendix 4). The layered and/or mature forest is located in the Mad River in the vicinity of Maverick Saddle and on the west face of Entiat Ridge on the Lake Wenatchee Ranger District. Most created openings within this group are largely the result of the Tyee Fire.

Species composition in the group depending on the degree of moisture available. At the moist end western white pine was an important component before the introduction of white pine blister rust (Chiwawa Initial LSR Assessment, see Disturbance section). Moist associations typically include a shrub component typified by species such as *Acer circinatum*, *Spiraea betulifolia*, *Rosa gymnocarpium*, *Clintonia uniflora*, and *Asarum caudatum* (Chiwawa LSR Initial Assessment).

#### d) Subalpine Fir Series

The subalpine fir series constitutes 16% (17,344) of the Chiwawa LSR. More than one-third (42%, 7,377 acres) of this series is mapped as layered or mature, while 26% (4,521 acres) is mapped as created openings and 28% (4,798 acres) as single layered stands (appendix 4). This series is concentrated along Entiat Ridge.

Subalpine fir is the most widespread species within the overstory (Wenatchee National Forest, Ecology Plot Database). Common seral dominants include lodgepole pine, Engelmann spruce, and western larch.

#### e) Wet Forest Group

The largest portion of the Chiwawa LSR consists of the wet forest group (32%, 34,398; Appendix 4). In general, this forest group can be found in the northern portion of the LSR. Nearly three-quarters (72%, 24,853 acres) of this forest group consists of layered or mature stands. Created openings are largely the result of past timber harvest and are mostly located in the vicinity of Grouse Creek Campground.

The wet forest group within the Chiwawa LSR is a fairly contiguous. Western hemlock and western red cedar are the most common overstory dominants forming contiguous forest. Mountain hemlock becomes more important at higher elevations on Chiwawa Ridge. Douglas-fir is the primary seral dominant in this forest group, but both lodgepole and western white pine are present, although scattered. Understory shrubs include *Oplopanax horridum* and *Acer circinatum*, and herbs include *Clintonia uniflora*, *Asarum caudatum*, *Berberis nervosa*, and *Arctostaphylos nevadensis*.

#### f) Valley Bottom Mixed Conifer

A small amount of this forest group was mapped within the Chiwawa LSR, which underestimates the actual acreage. The acres that were identified was accomplished through aerial photo interpretation which was only completed in the southern portion of the LSR. The vegetation modeling in the northern portion did not distinguish this vegetation group from the wet forest group. It is estimated that approximately 8% of the Chiwawa LSR consists of this forest group. This means that the modeling overestimated the actual amount of wet forest and, to a lesser degree, moist grand fir.

A recent study by Kuhlmann and Harrod (unpubl. report) reports the results of one year of post-fire monitoring on *I. longisepala*. This study found that post-burn populations are younger than unburned populations based on an analysis of morphological characters. Greater percent vegetative and lower percent reproductive plants were also present in burned sites. These results suggest that *I. longisepala*, in fact, may respond to fire similar to that of *I. rivularis* which has fire-stimulated germination (Crane and Fischer 1986).

### k) Survey and Manage Species

There are a number of survey and manage plant species known to occur in the Chiwawa LSR (Appendix 7). A few species are suspected, even more are simply unknown (Appendix 7). The ROD provides standards and guidelines for survey and manage species, and these should be addressed within the Chiwawa LSR. An important point is that only very general surveys have been completed for non-vascular plants and projects should be initiated which carry out extensive surveys.

**Table 29, Sensitive and Survey and Manage Species in Chiwawa LSR**

Group	Latin name	Common name	Federal *	State +	Forest Service ++	Presence **
FUNGI	<i>Albatrellus ellisii</i>				SM	K
FUNGI	<i>Albatrellus flettii</i>				SM	K
FUNGI	<i>Alpova alexsmithii</i>				SM	S
FUNGI	<i>Arcangeliella crassa</i>				SM	S
FUNGI	<i>Boletus haematinus</i>				SM	S
FUNGI	<i>Boletus pulcherrimus</i>				SM	S
FUNGI	<i>Bondarzewia montana</i> (= <i>B. mesenterica</i> )				SM	S
FUNGI	<i>Cantharellus cibarius</i>				SM	K
FUNGI	<i>Cantharellus formosus</i>				SM	S
FUNGI	<i>Cantharellus subalbidus</i>				SM	K
FUNGI	<i>Cantharellus tubaeformis</i>				SM	S
FUNGI	<i>Catathelasma ventricosa</i>				SM	S
FUNGI	<i>Choiromyces alveolatus</i>				SM	S
FUNGI	<i>Clavariadelphus borealis</i>				SM	S
FUNGI	<i>Clavariadelphus ligula</i>				SM	S
FUNGI	<i>Clavariadelphus pistillaris</i>				SM	K
FUNGI	<i>Clavariadelphus truncatus</i>				SM	K
FUNGI	<i>Clavulina cristata</i>				SM	S
FUNGI	<i>Clavulina ornatipes</i>				SM	S
FUNGI	<i>Collybia bakerensis</i>				SM	S
FUNGI	<i>Cortinarius magnivelatus</i>				SM	S
FUNGI	<i>Gastroboletus ruber</i>				SM	S
FUNGI	<i>Gastroboletus subalpinus</i>				SM	S
FUNGI	<i>Gastroboletus turbinatus</i>				SM	S
FUNGI	<i>Gomphus bonarii</i>				SM	K
FUNGI	<i>Gomphus clavatus</i>				SM	K
FUNGI	<i>Gomphus floccosus</i>				SM	K
FUNGI	<i>Gomphus kauffmanii</i>				SM	K
FUNGI	<i>Gyromitra californica</i>				SM	S

Group	Latin name	Common name	Federal *	State +	Forest Service ++	Presence **
PLANTS		moonwort				
VASCULAR PLANTS	<i>Botrychium simplex</i>	little grape-fern		S		S
VASCULAR PLANTS	<i>Campanula lasiocarpa</i>	Alaska harebell		S		S
VASCULAR PLANTS	<i>Carex buxbaumii</i>	Buxbaum's sedge		S		K
VASCULAR PLANTS	<i>Carex proposita</i>	smoky mountain sedge		S		S
VASCULAR PLANTS	<i>Cephalanthera austineae</i>	phantom orchid		M3		K
VASCULAR PLANTS	<i>Cicuta bulbifera</i>	bulb-bearing water-hemlock		S		K
VASCULAR PLANTS	<i>Cypripedium fasciculatum</i>	clustered ladyslipper	SP	T	SM	S
VASCULAR PLANTS	<i>Cypripedium montanum</i>	mountain ladyslipper			SM	K
VASCULAR PLANTS	<i>Epipactis gigantea</i>	giant hellebore		S		S
VASCULAR PLANTS	<i>Hackelia hispida</i> var. <i>disjuncta</i>	sagebrush stickseed		S		S
VASCULAR PLANTS	<i>Iliamna longisepala</i>	longsepal globemallow		S		K
VASCULAR PLANTS	<i>Orobancha pinorum</i>	pine broomrape		S		S
VASCULAR PLANTS	<i>Pellaea breweri</i>	Brewer's cliff-brake		S		S

Key to Columns: “\*” **Federal status** - “SP” = Special Protection; “+” **Washington state status** - “S” = Sensitive, “T” = Threatened, “E” = Endangered; “++” **Forest Service designations** - “SM” = Survey and Manage; “\*\*” **Present (or absent in LSR/MLSA)** - “K” = Known, “S” = Suspected

### 1) Noxious Weeds

A portion of the Chiwawa LSR was surveyed in 1992 for noxious weed species that occur along roadsides (McRae and Harrod unpubl. report). High densities of *Centaurea diffusa* are present along roads particularly along the main Chiwawa River Road. Other species include *Chrysanthemum leucanthemum*, *Hypericum perforatum*, *Cytisus scoparius*, *Cynoglossum officinale*, and *Cirsium canadensis*. Surveys for species presence and extent should be completed in order to develop a noxious management plan for this LSR (refer to Harrod 1994).

## 2. Late Successional Associated Wildlife Species

### a) Introduction

Most of the descriptive information regarding the Chiwawa LSR can be found within the Chiwawa Late-Successional Reserve Initial Assessment (USFS 1996). However, this initial assessment only addressed the portions of the LSR that were affected by the 1994 Tyee fire. Therefore, some vegetation types were not covered and some species not addressed over the entire LSR. This

the LSR. The Chiwawa LSR is capable of having 81,300 acres or 76%, in suitable spotted owl habitat. A summary of the amount of habitat within a 1.8 mile radius of the activity centers can be found in Appendix 15. Currently, 14 (74%) of the activity centers are below threshold level for habitat available within a 1.8 mile radius, two (10%) is at the threshold level, and three (16%) are at optimum habitat levels. Three of the spotted owl sites below threshold were severely burned by the Tyee fire in 1994, (SO506, SO509, SO510), they will need to be monitored for site validity.

**Table 30, Spotted Owl Status and Habitat Information for the Chiwawa LSR**

Spotted owl	Status <sup>3</sup>	Owner ship <sup>4</sup>	Dry or Wet Owl <sup>5</sup>	Threshold <sup>6</sup>	Critical Habitat Unit (CHU)	Forest Interior? <sup>8</sup>	Suitable Spotted Owl <sup>10</sup> Habitat	Total Dispersal Habitat <sup>9</sup>
*SO506	PY	FS	Dry	Below Threshold	WA-6		* 552	2,450
*SO509	PY	FS	Dry	Below Threshold	WA-6		* 640	2,402
*SO510	PY	FS	Wet	Below Threshold	WA-6		* 1,232	1,091
SO 512	RS	FS	Wet	At Threshold	WA-6	Inside	3311	802
SO 514	RS	FS	Dry	Below Threshold	WA-6		3034	489
SO604	P	FS	Wet	Optimum	WA-6	NEAR	4,836	1,051
SO605	PY	FS	Wet	Below Threshold	WA-6		4,311	1,471
SO621	PY	FS	Wet	Optimum	WA-6		4,456	1,635
SO627	PY	FS	Dry	Below Threshold	WA-6		1,675	1,763
SO630	PY	FS	Dry	Optimum	WA-6	NEAR	4,519	492
SO633	PY	FS	Dry	At Threshold	WA-6	INSIDE	3,448	1,009
SO634	RS	FS	Dry	Below Threshold	WA-6	NEAR	2,484	1,864
SO638	P	FS	Wet	Below Threshold	WA-6	NEAR	3,124	1,167
SO645	P	FS	Wet	Below Threshold	WA-6		1,715	1,385
SO649	PY	FS	Wet	Below Threshold	WA-6		2,969	1,312
SO708	PY	FS	Dry	Below Threshold	WA-6		1,434	3,275
SO714	PY	FS	Dry	Below Threshold	WA-6 <sup>7</sup>		1,326	3,053
SO731	PY	FS	Dry	Below Threshold	WA-6 <sup>7</sup>		1,650	2,649
SO749	PY	PVT	Dry	Below Threshold	WA-6 <sup>7</sup>		1,695	1,594

<sup>1</sup> Near the LSR or MLSA but not inside the LSR or MLSA.

<sup>2</sup> Spotted owl site overlaps with other LSR/MLSA.

<sup>3</sup> RS = Residential Single; P = Pair; PY = Pair with Young, based on highest occupancy.

<sup>4</sup> FS = Forest Service; PVT = Private Ownership (ownership at activity center).

<sup>5</sup> If the majority of suitable spotted owl habitat in .7 mile circle is dry or mesic, then it is a dry spotted owl. If the majority is wet, then it is a wet spotted owl.

if the fringed myotis and western big-eared bat occur within the LSR. The only one of these sensitive bat species known to occur in this LSR is the Yuma myotis.

Surveys for the lynx and wolverine have been conducted over about 10% of their habitat and surveys for the fisher have covered about 30% of their habitat. All three of these species are known to occur within this LSR.

#### f) Management Indicator Species

There are 13 wildlife species that are identified as Management Indicator Species and occur within the Chiwawa LSR. These include the pileated woodpecker (*Dryocopus pileatus*), downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), three-toed woodpecker (*Picoides tridactylus*), red-breasted sapsucker (*Sphyrapicus ruber*), Williamson's sapsucker (*Sphyrapicus thyroideus*), northern flicker (*Colaptes auratus*), ruffed grouse (*Bonasa umbellus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elephus*), mountain goats (*Oreamnos americanus*), beaver (*Castor canadensis*), and marten (*Martes americana*).

##### (1) Primary Cavity Excavators

The pileated woodpecker, downy woodpecker, hairy woodpecker, three-toed woodpecker, and northern flicker are all known to occur within the Chiwawa LSR. The red-breasted sapsucker and Williamson's sapsucker are suspected to occur within the LSR. Surveys for the pileated woodpecker, downy woodpecker, hairy woodpecker and three-toed woodpecker have been completed on about 5% of their habitat within the LSR. No surveys have been completed for the remaining MIS primary cavity excavators.

##### (2) Ruffed Grouse and Beaver

The ruffed grouse and beaver are both known to occur within the Chiwawa LSR. About 5% of the habitat has been surveyed for the ruffed grouse and 10% for the beaver.

##### (3) Mule Deer, Elk and Mountain Goats

The mule deer, elk and mountain goats are all known to occur within the Chiwawa LSR. All of the habitat for mule deer and elk has been surveyed and about 70% of the habitat for mountain goats has been surveyed.

##### (4) Marten

Marten are known to occur and about 30% of their habitat has been surveyed within the Chiwawa LSR.

#### g) Survey And Manage, Protection And Buffer Species

There are twelve wildlife species that are specific survey and manage or protection and buffer species that do or could occur within the Chiwawa LSR. These include the larch mountain salamander (*Plethodon larselli*), great gray owl (*Strix nebulosa*), flammulated owl (*Otis flammeolus*), white-headed woodpecker (*Picoides albolarvatus*), black-backed woodpecker (*Picoides arcticus*), pygmy nuthatch (*Sitta pygmaea*), silver-haired bat (*Lasionycteris noctivagans*), pallid bat (*Antrozous pallidus*), warty jumping slug (*Hemphillia glandulosa*), blue-gray tail-dropper (*Prophysaon coeruleum*), papillose tail-dropper (*Prophysaon dubium*), and Washington dusky snail (*Lyogyrus n. sp. 2*).

##### (1) Birds

No surveys for the great gray owl have been completed, however, they are known to occur. The flammulated owl and pygmy nuthatch are suspected to occur and no surveys have been completed. The white-headed woodpecker and black-backed woodpecker are known to occur and surveys have been completed over about 5% of their habitat.

## (1) Campgrounds

**Table 31, Campgrounds - Number of Units and Use Levels for the Chiwawa LSR**

Campground	No. of Units	Use Levels
Alder Creek Horse Camp	1	Low
Goose Creek Campground	25	Moderate
Deer Camp	3	Low
Grouse Creek (reservation site)	N/A	Moderate-High
Meadow Creek	4	Low
Riverbend	5	Moderate
Finner	3	Moderate
Rock Creek	3	Moderate
Chiwawa Horse Camp	20	Moderate
Schaefer Creek	7	Moderate
Atkinson Flat	6	Moderate
Alpine Meadows	4	Moderate
19 Mile	4	Moderate
Phelps Creek	7	Moderate
Phelps Creek Horse Camp	4	Recently Constructed

## (2) Dispersed Camping

Camping at undeveloped sites in the drainage is very popular. A number of sites are located in the Chiwawa River valley bottom, adjacent to the road and/or Chiwawa River. As with many other locations throughout the Forest, dispersed camping in more remote locations occurs during hunting season.

## (3) Trails

There are many miles of trails on the district. Some trails provide access to the Glacier Peak Wilderness, some are non-motorized trails designed to serve equestrians using the drainage for day-rides and some are open to motorized use associated with the motorized trails in the Chikamin drainage and into the Entiat Ranger District.

## (4) Other Recreation Uses

The Chiwawa (#6200) and Sugarloaf (#5200) roads are popular with sightseers. The Chiwawa road receives moderate traffic while the Sugarloaf road (a more primitive road) receives a lower level of traffic.

## (5) Winter Use

The Chiwawa drainage receives very heavy snowmobile use. There are several sno-parks located near the emergency airfield, state park, and Fish Lake providing access to the drainage. The Forest Service, with state funding, grooms the Chiwawa River road to Trinity. In addition a number of other roads are groomed up toward Pole Ridge and Maverick Saddle area. Although dependent upon the snow cover, the snowmobiling season extends from early December to late March.

## c) Minerals

Although the area had a history of mining, very little mining is underway today. A small pumice mine up the Chikamin drainage extracts pumice, however production is quite low and may, depending upon the market, be non-existent in some years. Exploratory work for gold and silver in the Chikamin drainage has been underway for about five years however no discoveries have been made to pay for further development.

**Potential Projects - Commercial Thinning**

2. Encourage private land owners in these areas to take similar density management action on private forested areas.

**Potential Projects - Communicate need to local landowners.**

3. Reduce fuel loadings along roads that exist between these LSR's to increase the roads effectiveness as fuel-breaks.

**Potential Projects - Piling of down fuels, firewood gathering, pruning to reduce vertical fuel concentrations (all vegetation types), construction of shaded fuel-breaks.**

4. Improve and maintain the BPA powerline as a fuel-break between the Chiwawa and Eagle Creek and the Chiwawa and Natapoc.

**Potential Projects - Plant or encourage growth of less flammable deciduous vegetation within the powerline corridor, remove dead fuels from corridor.**

5. Reduce fuel loadings in young stands.

**Potential Projects - Precommercial thinning.**

## 2. Northern Spotted Owl

The following is the discussion and results of the Forest-wide Spotted Owl Module for the Chiwawa LSR. See appendix for order, explanations and process of modules.

The Chiwawa LSR is one of the "big three" LSR's, which is important as sources for spotted owl distribution throughout the North Cascades province. Being that it is on the far northeastern edge of the range of the spotted owl, the Chiwawa LSR is important for range-wide distribution. It is the only large population cluster/source center on the north half of the Wenatchee National Forest. Much of the habitat in the central and south portions of the LSR are highly roaded and fragmented, which may take time to fully recover suitable spotted owl habitat. This LSR provides essential breeding habitat connectivity with the Glacier Peak Wilderness and Little Wenatchee LSR to the north/west, Shady Pass LSR to the northeast, and Deadhorse LSR/Natapoc MLSA to the south/southwest, and Eagle MLSA to the south. Further east is beyond the range of the northern spotted owl.

There is 49,489 acres (46%) of nesting, roosting and foraging habitat for spotted owls in this LSR, this is one of the highest amounts of suitable spotted owl habitat on the Forest LSR/MLSA's. It also has one of the highest amount of potential N/R/F habitat (81,567 acres), as well as sustainable habitat potential (wet, moist, high elevation).

For these large LSR's to function as source populations, at least 20 pairs of owls should be managed for (see Table 33 "Spotted Owl Pair Goals for 'Big e' LSR's" below). Currently there are 19 spotted owl activity centers within the Chiwawa LSR. Early historical reports of spotted owls show they have been part of these ecosystems at least since 1941 in the Lake Wenatchee area (Condor 1946). The current 19 activity centers include 16 spotted owl pairs. However, as a result of the Tyee fire in 1994, 3 pair sites (SO506, SO509 and SO510) were severely burned, and may not continue to function as a home range. In addition, 4 other sites were affected by the burn, and acreage dropped below threshold (SO627, SO634, SO638 and SO645). (See Table 1: "Spotted Owl Status and Habitat Information" and suitable spotted owl habitat and activity center map.).

**Table 33, Spotted Owl Pair Goals for "Big 3" LSR's with CHUs"**

Source Center LSR	S.Owl Pairs -1994, FSEIS Appendix G, Table G-3	S.Owl Pairs - 1996	Number of Owl Pairs LSR Should Support, as per CHU discussion.
Chiwawa RW 135	11 Pairs + 1 Res Single	16 Pairs + 3 Res Singles	21+ Pairs

dependent on vegetation between the Chiwawa LSR and Shady Pass and Slide Peak LSR's, and Twin Lakes, Natapoc, and Eagle Creek MLSA's for connectivity for all dispersal classes. The one exception is that species with high dispersal capability are connected with the Natapoc MLSA. The dry forest vegetation group is absent from the Twin Lakes MLSA, so there is no connectivity.

Relative to species associated with the moist grand fir vegetation group, connectivity only exist with the Twin Lakes MLSA. Connectivity to Shady Pass and Slide Peak LSR's and Natapoc and Eagle Creek MLSA's is either absent or there is no connectivity because of the great distances.

There is connectivity for the subalpine fir series between the Chiwawa and the Shady Pass LSR, but this series absent from Natapoc and Eagle Creek MLSA's. Connectivity in this series between the Chiwawa and Slide Peak LSR's is dependent on vegetation in between for all dispersal classes.

Species associated with the wet forest group are connected to the Twin Lakes MLSA for all dispersal classes. Also, there is connectivity with the Shady Pass LSR for species with high and moderate dispersal abilities, but low dispersal species are dependent on vegetation in between. This forest group is absent from the Slide Peak LSR and Natapoc and Eagle Creek MLSA's.

Although whitebark pine is present in the Chiwawa LSR, this vegetation type is absent from the surrounding LSR's or MLSA's, so no connectivity exists.

No projects were identified to improve connectivity of habitat's between LSR's or MLSA's. Disconnectivity identified in this analysis results from inherent breaks in the vegetative landscape

#### b) Wildlife Connectivity

The following are the results of applying the forest wide connectivity module to the Chiwawa LSR (refer to the Dispersion Index in Appendix A). A total of four potential linkages were evaluated for this LSR. These included Chiwawa to Shady Pass LSR, Chiwawa to Eagle Creek MLSA, Chiwawa to Twin Lakes MLSA, and Chiwawa to Deadhorse LSR.

**Table 34, Dispersal Indices for the Chiwawa Forest Wide Connectivity Module.**

Linkage	Distance (MI)	Low	Moderate	High	Index
Ch/Shady Pass	1.6	No	Yes	Yes	3
Ch/Eagle Creek	1.9	No	Yes	Yes	2
Ch/Twin Lakes	0	No	Yes	Yes	2
Ch/Deadhorse	1.6	No	Yes	Yes	2
<b>Overall Rating</b>					<b>2.2</b>

#### c) Restoration Opportunities

It is recommended that a more site specific analysis be conducted to verify if the linkage between Chiwawa and Shady Pass provides for low mobility species, and if Chiwawa and Twin Lakes has the potential to provide for low mobility species. Clear cuts within the linkage between Chiwawa and Twin Lakes could be a potential dispersal barrier for low mobility species. Habitat development in these areas could be evaluated and potential restoration opportunities, such as stand density management, identified. These activities could provide additional connectivity for the low mobility species.

### C. Analysis Within LSR/MLSA

#### 1. Unique Habitat and Species

The Chiwawa has the second highest quality of providing high connectivity in a landscape pattern for biological flow to sustain unique animal and plant communities. This includes the amount, percent and number of patches of late successional habitat, forest interior habitat patches, and the juxtaposition of wilderness and areas of rarity. The Manastash LSR is the highest.

### (3) Process and Function of Unique Habitats and Species

The Chiwawa is again the second highest at providing quality functioning for unique species and habitat. This includes development and maintenance of unique ecosystems, including ecological values for unique species and populations. The plant and animal species list for known observations makes up a large part of this analysis, as well as proximity to wilderness and areas of rarity, which sustain habitat function.

Identified areas of high abundance, connectivity and function for unique habitats and species in the Chiwawa LSR are:

1. McCall Mountain to Maple Creek: Cliffs, Talus, wet lands, meadows, shrubs, forest interior, whitebark pine/subalpine larch, deciduous and GPW.
2. Willow Creek to Chipmunk Creek: Forest interior, whitebark pine/subalpine larch, meadows, talus, cliffs, riparian reserves, shrubs, late successional forest, GPW.
3. Upper Chikamin/Marble Creek/Garland Peak: Wetlands, riparian reserves, talus, forest interior, whitebark pine/Subalpine larch, meadows, wet meadows, shrubs, PETS spp, Glacier Peak Wilderness.
4. Cougar Creek area: Talus, wetlands, meadows, PETS spp, forest interior, riparian reserves, late successional forest.
5. Chiwawa Valley Bottomland: Grouse Creek to Buck Creek. Major wetlands, salmon, late successional forest, forest interior, PETS species, GPW.
6. Upper Goose to Maverick Saddle: Forest interior, late successional forest, talus, cliffs, riparian reserves, shrubs, natural openings, PETS species.
7. Rock Creek: Forest interior, late successional forest, riparian reserves, natural openings, PETS species, GPW.
8. Hornet Ridge: Natural opening, ponderosa pine old growth, PETS spp, riparian reserves.
9. Morrow Meadows to Grouse Creek: Meadows, wetlands, riparian reserves, shrubs.
10. Lower Beaver Creek: Riparian reserves, forest interior, wetlands, natural openings.

The following is a summary of the Unique Habitats and Species Module. For more information see Unique Habitats Map and Tables, Forest Interior Map and Tables, Riparian Reserves and Roading Map and Tables.

### c) Unique Habitats And Species Module

#### Landscape Analysis:

- Within Bioregion Center Of Species Rarity and Endemism  
For Plants and Animals in North, and For Plants in South,
- Includes Hornet Ridge Potential Botanical Area.

#### Micro-site Analysis:

**RIPARIAN RESERVES 13% of LSR**  
Streams, Rivers, Wet Meadows,  
Seeps, Lakes.

**NON-FORESTED VEG 4% of LSR**  
Talus/Cliffs 1%, Shrubs 1%, Subalpine  
Mdw 1%, Natural Openings, Deciduous.

#### **SURVEY & MANAGE PROTECTION & BUFFER**

Lynx, Great Gray Owl,

#### **UNIQUE FORESTS**

Forest Interior Patches 10%,

A landscape level approach was used to analyze snag, green tree recruitment, and downed wood habitat in the Chiwawa LSR. The landscape approach reviews the quality of snag, down logs, and green tree recruitment for the LSRs. GIS and specific knowledge was used: including: forest vegetation types and acreages, amount of forest burned, percentage of past timber harvest (clearcuts and partial cuts), road densities, security habitat, Riparian Reserve acreages, pathogens, the number of spotted owl home ranges, forest interior amounts, and the percentage of late successional habitat. The qualitative analysis for the LSR included green tree availability, short term and long term snag/log availability, burn intensity, site specific wildlife needs, land allocation goals, and the quality of refugia/security habitats.

### (1) Quality Rating

Each attribute for snag/downed log/green tree recruitment has a rating (see chart), a final rating incorporates all values towards one rating for the LSR. Actual snag, downed log and green tree recruitment numbers, sizes, stages of decay and species is not practical to analysis on a landscape basis. This can also be done on a 40 acre grid, or sub-watershed basis. When data is available, incorporate actual availability data into the analysis. Snag and Downed Log levels are based on WNF Snag Levels, Fire Recover y Snag Levels, Everett et al Spotted owl and Snag studies, and wildlife needs. Qualitative ratings are based on habitat needs for snag, downed log, and recruitment tree wildlife and plant species needs. Species using these habitats include:

pileated woodpecker	spotted owl	hoary bat	marten & fisher	tailed frog
black-backed woodpecker	flamulated owl	silver-haired bat	flying squirrel	NW & PG salamander
white-headed woodpecker	great gray owl	big brown bat	lynx	lichens & fungi
olive-sided flycatcher	Vaux's swift	voles, shrewmole	bald eagle	land snails

### CHIWAWA

<u>HIGH QUALITY</u>	<u>MEDIUM QUALITY</u>	<u>LOW QUALITY</u>
Moist & Wet Veg Groups 49%	Subalpine Fir & Mesic Veg 19%	Dry & Whitebark Veg 25%
>60% LS (non-dry) Habitat	15% - 60% LS Habitat 42%	<15% LS Habitat
80% - 100% LS (all) Habitat	40% - 80% LS/M Habitat 62%	<40% LS/M Habitat
> 30% Forest Interior (non-dry)	15% -29% Forest Interior Non-dry	<15% Forest Interior ND 10%
>10% Forest Interior Dry	5% - 9% Forest Interior Dry	< 5% Forest Interior Dry 2%
>16% in Riparian Reserves	10% to 16% in Riparian Reserves 13%	<10% in Rip Res
0 Mi/Sq Mi Any Rds in Rip Res	0 to 1 Mi/Sq Mi Rds in Rip Res	> 1 Mi/Sq Mi Rd Rip Res 3.14 mi/sq/mi
< 1 Mi/Sq Mi Open Roads	1 Mi to 2.5 Mi/Sq Mi Roads 1.9 mi/sq/mi	> 2.5 Mi/Sq Mi Roads
>70% Security Habitat	50% to 70% Security Habitat	<50% Security Habitat 36%

Connect Var.	Dry	Mesic	MGF	Wet	SAF LPP	Overall	@@@ Name?
Open Road Density	L	L	M	M	M	M	M
Security Habitat	L	L	M	M	M	M	L
Inter. Forest Rds	L	L	L	L	L	L	L
%Inter. Forest	L	L	L	L	L	L	L

#### (1) Restoration Opportunities

The current open road density is 1.90 mi./sq.mi. and the level of security habitat is 36%. The within LSR connectivity could be improved by identifying roads that could be closed. Consideration should be given to revegetating closed roads to provide for dispersal of low mobility species.

Additional restoration opportunities to improve habitat connectivity within the Chiwawa LSR could include acquisition of the Alder Creek and Chikamin Flats land parcels.

Within the Dry Forests, fuels reduction and prescribed fire could be used to enhance the connectivity of the fire-climax ponderosa pine habitats. This would need to be completed in close coordination with spotted owl habitat needs as the Chiwawa LSR is one of the "big three" and is designed to provide a "source" for spotted owls into other LSR/MLSAs.

Within the Mesic, Moist Grand Fir and Wet Forest groups tree density management of sites identified as created opening or single layered could be used to promote the development of late-successional conditions.

#### (2) Habitat Effectiveness

Habitat effectiveness within the Chiwawa LSR was assessed using the current open road density and the amount of security habitat. The current open road density is 1.9 mi./sq.mi. and the current level of security habitat is 36%. Based upon these variables, the current level of habitat effectiveness for these species is "low to moderate". The habitat effectiveness for late-successional species could be greatly improved through the reduction of open road densities and an increase in the levels of security habitat. This could be accomplished during access and travel management planning.

### 3. Disturbance, Risk Analysis

Twenty-five percent of the Chiwawa LSR is in the dry forest group; of that, over half is successional-advanced.

The lower portion of the Chiwawa LSR below Grouse Creek is heavily roaded and much of this area has been harvested in the past. This amounts to about 25 percent of the LSR being harvested, with both partial cutting and clear cutting. There are 15 developed campgrounds within the LSR; recreational use is heavy, including some motorized trails. Heavy recreational use increases the potential for human-ignited fires.

The Chiwawa River is a wide meandering river that would effectively halt the spread of low and moderate severity fires; spotting from wind-driven crowning fires has the potential of spreading fires across this natural barrier. The river itself is a disturbance agent within this LSR, albeit one that frequently increases floral and faunal diversity by providing a variety of habitats along its banks. Because the river meanders within a wide floodplain, many successional stages will be present within the riparian zone.

Ve g Ty pe	Fire	Dwarf Mistletoe DF	Root disease			WPB R	WSB	DFB	FE	MPB	Total
			AROS	HEAN	PHWE						
30	L	M	L	M	M	H	L	L	L	-	M
31	L	M	L	M	M	H	L	L	M	-	M
32	H	H	L	M	M	H	M	M	M	-	H
33	H	H	M	H	M	H	M	M	M	-	H
40	L	L	L	L	L	H	L	L	L	-	L
41	M	L	L	L	L	H	L	L	L	M	M
42	H	L	L	L	L	H	L	M	M	-	H
43	L	-	L	L	L	H	L	L	L	-	L
44	L	-	L	L	L	M	L	L	L	-	L
50	L	L	L	L	L	M	L	L	L	M	L
51	M	L	L	L	L	M	L	L	L	-	L
52	H	L	L	L	L	M	L	L	L	-	M
60	L	L	L	L	M	H	L	L	L	-	L
61	L	L	L	L	M	H	L	L	L	-	L
62	M	L	L	M	M	H	L	M	M	-	M
63	L	-	L	L	L	H	L	L	L	-	L
65	L	L	L	L	M	H	L	L	L	-	L
71	M	-	L	L	L	H	-	L	L	M	L
80	L	-	L	L	L	-	-	L	L	-	L

**Key to Column Headings:** PP = Ponderosa Pine, DF = Douglas-fir, WL = Western Larch, PIPO = Ponderosa Pine; PSME = Douglas-fir; LAOC = Western Larch; AROS = Armillaria root disease; HEAN = Annosus root disease; PHWE = Laminated Root Disease, WPBR = White Pine Blister Rust; WSB = Western Spruce Budworm; DFB = Douglas-fir Beetle; FE = Fir Engraver, MPB = Mountain Pine Beetle; WPB = Western Pine Beetle.

**Key to Letters** “-” = no risk = 0; “L” = low risk, “M” = moderate risk, “H” = high risk

Thirty-five percent of the Chiwawa LSR has a high composite risk to disturbances. Areas at risk include the dense, dry forest types, the partially-harvested dry forests, the mesic sites within dry forest, layered mature and partially-harvested moist grand fir, and the layered subalpine fir forests. The moist grand fir and subalpine fir types are at risk because of their adjacency to drier forests and because insect and pathogen activity has elevated fuel loads and vertical and horizontal fuel connectivity within these vegetation types.

This LSR is a major population center for the northern spotted owl; therefore management options must take into account that protecting and enhancing habitat for this species is the primary goal. The Tye Fire (1994) destroyed or modified some of the suitable spotted owl habitat within the LSR; an important objective is to replace lost habitat as rapidly as possible within other areas of the LSR.

Management within this LSR will also focus on protecting existing spotted owl habitat around all activity centers. Management activities will primarily take place in non-spotted owl habitat within spotted owl circles or outside existing spotted owl circles. Management objectives to reduce risk of further habitat loss include creating or maintaining fuelbreaks within low elevation dry forest types east of Fish Lake.

	1.8 mile Circle Around Activity Center				0.7 mile Circle Around Activity Center				.33 mile Circle Around Activity Center <sup>11</sup>				Restoration
Spotted owl	Dry	Mesic	Wet	Total	Dry	Mesic	Wet	Total	Dry	Mesic	Wet	Total	
SO514	x	x		3,034	xx			unk				unk	mpa
SO604	80	0	4,757	4,836	0	0	894	894	0	0	191	191	m
SO605	417	0	3,894	4,311	42	0	451	492	0	0	82	82	ma
SO621	0	0	4,456	4,456	0	0	573	573	0	0	68	68	m
SO627	428	348	899	1,675	132	167	114	412	48	17	44	109	mpa
SO630	1,632	0	2,888	4,519	477	0	155	632	102	0	63	166	m
SO633	1,209	0	2,239	3,448	257	0	249	506	56	0	51	107	map
SO634	1,227	0	1,257	2,484	493	0	0	493	147	0	0	147	mpa
SO638	376	0	2,748	3,124	96	0	224	320	62	0	32	94	mpa
SO645	276	252	1,186	1,715	4	123	130	257	0	47	0	47	mpa
SO649	786	0	2,183	2,969	64	0	200	263	22	0	51	73	mpa
SO708	725	441	268	1,434	9	187	0	196	0	52	0	52	mpa
SO714	1,010	148	168	1,326	172	0	0	172	52	0	0	52	mpa
SO731	1,219	394	37	1,650	125	115	0	240	36	0	0	36	mpa
SO749	1,682	12	0	1,695	289	0	0	289	69	0	0	69	mpa

<sup>1</sup> Near the LSR or MLSA but not inside the LSR or MLSA.

<sup>2</sup> Spotted owl site overlaps with other LSR/MLSA.

<sup>3</sup> RS = Residential Single; P = Pair; PY = Pair with Young, based on highest occupancy.

<sup>4</sup> FS = Forest Service; PVT = Private Ownership (ownership at activity center).

<sup>5</sup> If the majority of suitable spotted owl habitat in .7 mile circle is dry or mesic, then it is a dry spotted owl. If the majority is wet, then it is a wet spotted owl.

<sup>6</sup> **Below Threshold:** < 2,663 total suitable spotted owl habitat acres in 1.8 mile circle or < 500 total suitable spotted owl habitat acres in 0.7 mile circle.

**At Threshold:** 2,663-3,994 total suitable spotted owl habitat acres in 1.8 mile circle.

**Optimum:** > 3,994 total suitable spotted owl habitat acres in 1.8 mile circle.

<sup>7</sup> The activity center is within 1/2 mile of the CHU.

<sup>8</sup> **Inside** = activity center is at least 600' inside (forest interior) late successional habitat.

**Near** = activity center is inside late successional habitat near forest interior.

<sup>9</sup> Habitat within 1.8 mile circle around activity center. Dry dispersal habitat includes vegetation codes 11, 13, and 52; mesic includes code 21; and wet includes codes 31, 35, 61, and 41.

<sup>10</sup> Dry suitable spotted owl habitat includes vegetation code 12 where size/structure is multistory greater than 9" DBH; mesic includes code 22; and wet includes codes 32, 36, 62, 64, and 42.

<sup>11</sup> A larger circle will be needed if there is less than 100 acres of suitable habitat

**Restoration Opportunities:** "m" Monitor site; "a" Accelerate habitat around site and home range;

"p" Protect what nesting/roosting/foraging habitat exists.

### c) Spotted Owl Dispersal And Connectivity

During dispersal, nesting, roosting, foraging habitat is used, as well as habitat of lower quality (dispersal habitat). Dispersal habitat includes single story stands, and smaller trees with at least 40% crown closure. Dispersal habitat within the LSR is 32,642 acres (30%) and will grow up to be nesting/roosting/foraging habitat. Habitat providing dispersal/Connectivity corridors within the Chiwawa LSR include: Cougar Creek, Jimmy Creek to Berg Creek, Maverick Saddle to upper Goose Creek, Chikamin Creek, Willow Creek, Rock Creek, from Grouse Creek west to Phelps Creek, Beaver Creek, and Chumstick Creek to Dry Creek to Second Creek (see Forest Interior map and Suitable Spotted Owl Habitat Map).

The function of dispersal/connectivity habitat for spotted owls depends on the amount and juxtaposition of late-successional, forest interior, and dispersal habitat. The Chiwawa has 42% in late-

12. Reduce road densities in: Lower Mad (4.91 mi./sqmi); Beaver Creek (3.9 mi./sq. mi.); Lower Chiwawa (3.8 mi./sq. mi.); and Middle Mad (3.42 mi./sq. mi.).
13. Maintain dispersal/connectivity habitat (Cougar Creek, Jimmy Creek to Berg Creek, Maverick Saddle to upper Goose Creek, Chikamin Creek, Willow Creek, Rock Creek, from Grouse Creek west to Phelps Creek, Beaver Creek, and Chumstick Creek to Dry Creek to Second Creek).

## 5. Aquatic

### a) Summary of Aquatic Goals

- Protect salmonid populations and habitat in core areas in the Chiwawa and Mad drainages.
- Prevent increase in water temperature in all drainages. Work to reduce maximum summer temperatures in the Mad River drainage.
- Minimize fine sediment input.
- Monitor streams within the Tyee Fire area for changes in temperature and sediment.
- Rehabilitate riparian reserves within the Tyee Fire area.
- Reduce groundwater to surface water conversion by roads.
- Evaluate road surfacing and maintenance with an emphasis on reducing sediment input.
- Reduce or avoid increase in riparian roads.
- Manage upslope vegetation, roads and activities to increase base flows, and to avoid increase in peak flows in the basins.
- Preserve and restore all floodplain, side channel, and riparian wetland habitat, especially in C and E channel types in the Chiwawa drainage.
- Protect and inventory upslope wetlands and ponds.
- Restore natural disturbance regimes (landslides, fire, flood, disease) as practicable.
- Discourage the spread of brook trout.
- Gather more information on non-salmonid aquatic biota.

### b) Key Issues

1. Core fish areas have been identified within and downstream of Chiwawa LSR. The Chiwawa drainage is a core area for spring Chinook salmon and bull trout. The Mad River drainage, within the Tyee Fire area, has core areas for bull trout, spring Chinook, and cutthroat trout.
2. Federal candidate species and other species of concern: bull trout populations in the Chiwawa and Mad could be impacted by LSR management activities.
3. Anadromous salmonid populations occur within and below Chiwawa LSR. Anadromous salmonids within the LSR include: steelhead, early-run (spring) Chinook salmon. Summer/Fall Chinook salmon are known absent.

Concerns include the low anadromous fish populations which are severely reduced from historic levels, within-population genetic and life-history diversity, condition of physical habitat and condition of water quality for incubation, rearing, over-wintering, migration, and spawning. Direct human interaction or harvest of individuals may potentially reducing fitness of the spawning population. All life stages are probably vulnerable to impacts that are caused by management actions.

Chiwawa reach increased in the second year of sample from 12-17% to >20% on average, samples were from 12-35%. The previous year's sample ranged between 6 and 25%.

Fine sediment data has not been collected in the Mad River.

9. Channel complexity. Channel complexity has implications for fish habitat and for the hydrologic regime (hydraulic retentivity). Components of channel complexity include: large woody debris (LWD), pool abundance, pool type, pool depth, width depth ratio, substrate diversity, sinuosity, cover, undercut banks, bank vegetation, riparian vegetation, roughness coefficient, hydraulic retentivity, riparian wetlands, side channels, high flow refugia, and floodplain connectivity.

LWD plays key roles in stream bed and stream bank stability, fines/gravel retention, sinuosity, pool formation, side channel creation, nutrient retention (e.g. deciduous leaves, salmon carcasses), and nutrient input. Single pieces function differently from interwoven masses of LWD known as complexes.

Input mechanisms: small scale riparian disturbances to large scale hillslope disturbances. Management can impact aquatic LWD regimes in a number of ways including: removal from channel; removal from floodplain (down and/or potential); alteration of floodplain area or of frequency of "small" floods; removal from hillslope; or alteration of disturbance regimes controlling input (landslides, avalanches, fire, flood, disease).

Riparian road density is often inversely related to channel complexity. Our information on channel complexity is far from complete; riparian road density and LWD and pool abundance data is available for selected (R6 protocol - surveyed) streams.

10. Aquatic nutrient cycling depends in part on riparian understory vegetation, groundwater /surface water partitioning, in-channel LWD, hydraulic retentivity, pool depth and character, macroinvertebrate community structure, mass wasting disturbance regime, and returning anadromous biomass. We have inadequate data to evaluate aquatic nutrient cycling in Chiwawa LSR at this time; however we can be aware of it when managing any of the above inter-related factors.
11. Landtype. Chiwawa LSR includes landtypes A, B and C. (see the Landtype Association Map) These landtypes are mapped on a gross scale, project level planning may find a need for more precise maps.
12. Channel type. In the absence of human influence, valley shape and geology determine the basic character of the stream channel. A steep boulder torrent, a moderate but continual step - pool - step, a broad meandering river, or a cliff-lined canyon, present different opportunities for aquatic biota. A given organism might require a number of different channel types for different aspects of its life. Various classification systems, such as Rosgen, have been constructed to characterize these differences. Common and fundamental to all systems are: 1) channel gradient, 2) channel confinement (the ability of the stream to move back and forth, or express sinuosity, often quantified as the width of the valley floor relative to the width of the channel), and 3) substrate size (whether the local geology provides huge boulders, moderate cobbles, or only sand and silt to the channel).

Channel type is a fundamental constraint on many other aquatic habitat parameters. The pools found in a steep boulder torrent will be fundamentally different from those in a broad meandering river in abundance, type, and depth. Human influences can alter conditions within a channel type (a meandering river could become shallower, silt filled, and lacking in riparian cover) or the channel type (a deep winding meadow trout stream could become a downcutting gully). If the channel type itself has been altered. It may never be possible to return a stream to its original condition ; however it may be possible to improve the channel condition that moves it toward the characteristics of the original, or at least stabilizes the channel (for example prevent further downcutting).

increased canopy in the watershed (usually through fire exclusion). Overstory canopy may have the greatest effect but understory vegetation, condition of the duff layer, and soil compaction are inter-related and also important, particularly in areas of drier climate. Vegetation, climate (precipitation patterns, rain-on-snow probabilities, and lightning strike patterns), and landtype interact

18. Floodplain connectivity. Historic photos might reveal changes in off-channel habitat, floodplain area and riparian wetland habitat over time. Some of the floodplain area along the Chiwawa is privately owned. Habitat improvement projects on National Forest land.
19. Upslope wetlands and ponds may serve as "islands" and/or refugia for aquatic biota, especially those that do not co-exist with salmonids. They also have important roles in regulating summer base flows in the watershed. We have information regarding wetland locations, but little understanding of alterations in their ecosystem functions over the recent centuries.

As a broad generalization wetlands, especially in late-successional forests may be havens of biodiversity warranting very conservative management until better inventoried and understood.

20. Disturbance Regimes. We have come to recognize that suppression or alteration of natural disturbance regimes can lead to fundamental long-term resource change. This in turn has led to the realization that minimum viable populations or habitats must be large enough to withstand moderate disturbances. A complete description of natural disturbance regimes, their relationship to landtype, climate, and other factors, and their ecosystem roles, is still lacking. Aquatic systems are now seen to depend on disturbance by fire, flood, insect/disease, and landslides for input of the raw materials of channel construction, such as LWD and coarse substrate

The LSR system comprises a set of landscape patches where retention or recreation of primeval conditions is emphasized, allowing the maintenance of wildlife dependent on these conditions. From the aquatic perspective, we consider how this system of reserves and the aquatic corridors that link them can be managed for maximal viability of native aquatic species and the habitat conditions in which they evolved.

Although historic aquatic conditions are not known to the degree desirable this much is clear: many aquatic populations have lost some of their spatial, temporal, and genetic "safeguards;" the nature of the disturbances they experience has changed; individual health/reserves may be reduced (for example salmon enduring longer migration times concurrent with higher temperatures); and habitat conditions have declined in non-random ways, fragmenting populations. The LSR network has the potential to strengthen viability of these at-risk aquatic populations.

## 6. Noxious Weeds

Six noxious weed species were identified to occur within the Chiwawa LSR. These species are discussed in priority order as identified by the noxious weed analysis module. There are no Class A presently documented from this area. Class B-designate weeds include: *Centaurea diffusa*, *Cytisus scoparius*, and *Chrysanthemum leucanthemum*. Class C species present include *Hypericum perforatum*, *Cynoglossum officinale*, and *Cirsium canadensis*. These species are found along roadsides within the LSR, particularly the main Chiwawa River Road. Following through the noxious weed analysis module, *Cytisus scoparius*, *Cynoglossum officinale*, and *Cirsium canadensis* are limited in extent and should be controlled or eradicated. The other species are more widespread and containment and prevention of spread should focus on areas of high recreation use such as Grouse Creek Campground, Rock Creek Horse Camp, and Rock Creek, Spider Meadows, Chikamin, and Trinity Trailheads. Harrod (1994) provides a brief synopsis of control methods available and provides recommendation for noxious weed management.

## 7. Fire Management Plan

- ◆ Emphasize prevention of fires adjacent to the LSR boundary. Work with private landowners and opinion leaders in the community of Plain. Do this on an interagency basis.
- ◆ Strategic fuel manipulation within and adjacent to LSR boundaries, live and dead, should be included in project design as appropriate.
- ◆ Emphasize roadside fuel modification in the Beaver Cr. and Chiwawa River drainages.

#### c) Fire Detection

1. Staffing of Sugarloaf and Alpine Lookouts supplemented by aerial detection after lightning episodes will provide the primary detection resource for this LSR.
2. Emphasize fire reporting procedures with Trinity mine site landowners and occupants.

#### d) Fire Suppression

1. Spotted owl activity centers are the highest priority for protection of resources (following protection of human life and improvements). All wildfires in the 1.8 mile buffer will be suppressed at minimum acres.
2. Rapid, aggressive initial attack will occur on all dry site ecosystems until vegetation management projects have modified the vegetative condition to where it is in synchrony with inherent disturbance regimes.
3. Develop a prescribed fire management plan for that portion of the LSR north of Estes Butte and adjacent to the Glacier Peak Wilderness. ( Ensure the protection of improvements )
4. Ignitions above 5000', northwest of Mad Lakes, along the district boundary between the Entiat RD. and Lake Wenatchee RD., and along the boundary of the Glacier Peak Wilderness near Schafer Lake, will be considered candidate fires and may be managed as prescribed fires after prescribed fire plans are completed.
5. Protection of riparian areas from fires and from disturbance during fire suppression activities is a priority.
6. Improvements will be a priority for protection ( recreation facilities, powerlines, Trinity Mine improvements, Sugarloaf Lookout and all guard station facilities).
7. Adjust pre-planned dispatch cards for the LSR. Utilize the following general direction:
  - ◆ Use of retardant is appropriate for initial attack.
  - ◆ Use of aerially delivered firefighters is appropriate
  - ◆ Use of dozers needs district ranger's approval.
  - ◆ Use of burning out is appropriate strategy as situation dictates.
  - ◆ Escaped Fire Situation Analysis process will be used to guide large fire suppression. Utilize pre-attack plans and materials. These may be prepared in advanced and updated annually prior to the fire season.

#### e) Vegetation Management

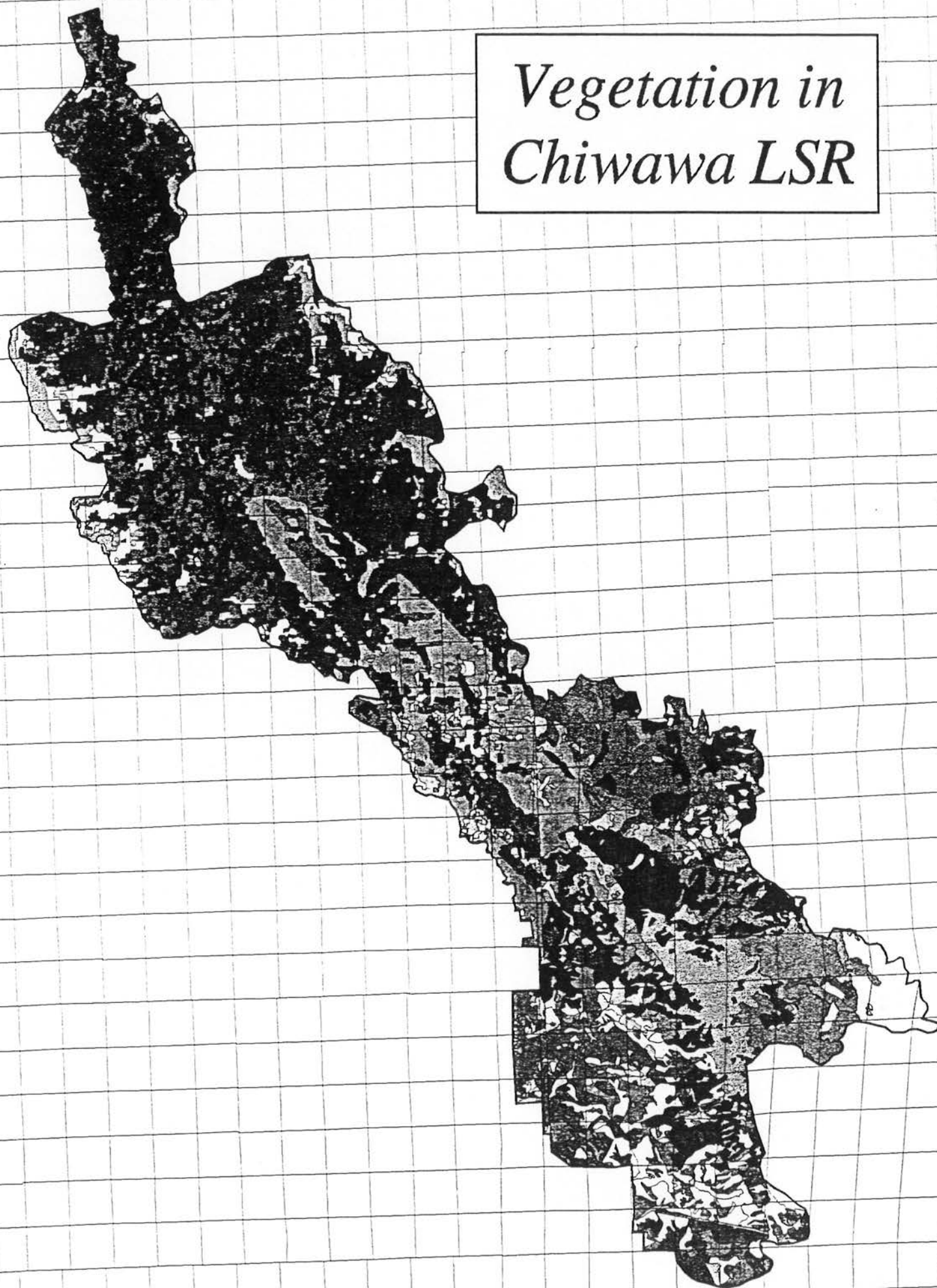
1. Returning dry forest types to sustainable conditions is a priority.
2. Suggested activities include pruning, thinning, commercial, pre-commercial thinning, wood gathering, and prescribed fire.
3. High density, multi-story refugia in mesic sites will be maintained.
4. Prevent the spread of noxious weeds as feasible.
5. Prescribed fire projects in whitebark pine/subalpine larch ecosystems are encouraged to increase amounts of whitebark pine.

Analysis Module	Restoration Opportunity	Potential Projects	Schedule 1
	BPA powerline as a fuelbreak between Chiwawa and Natapoc .	less flammable deciduous vegetation within the powerline corridor, remove dead fuels from corridor.	
	5) Reduce fuel loadings in young stands.	Precommercial thinning	C
<b>** Forest-Wide Spotted Owl</b>	1) Meet goals of 20+ pairs of spotted owls.	a) Protect spotted owl home ranges. b) Increase/Accelerate spotted owl habitat within LSR, especially on wet, moist or high elevation large trees.	
	2) Improve and accelerate N/R/F habitat to maintain high number of spotted owls.	a) Rehab and accelerate habitat in areas degraded or lost due to clear cuts, fires or insects. b) Thin of overstocked stands. c) Accelerate existing stands towards old growth, pruning etc.. d) Increase canopy closure.	
	3) Reduce fuel loading and stocking levels in dense successional advanced dry forest stands where they exist between the Chiwawa and both Eagle and Natapoc LSR/MLSA's	1) Use commercial thinning, pruning, fuelwood collection and prescribed fire as described in disturbance module treatment key. Favor the development of seral species such as ponderosa pine and western larch. Locate and prescribe sufficient treatments to make landscape level changes in fire susceptibility	A
	4) Monitor/maintain connectivity outside LSR in wilderness and in key locations.	Note connectivity provided outside LSR/MLSA and overlap onto riparian reserve, wilderness, etc. Maintain.	
	5) Monitor spotted owl activity centers below targeted habitat acreages.	See list of owl sites in need of monitoring for site tenacity and reproduction status.	
<b>Forest-Wide Connectivity</b>	1) Verify linkage between the Chiwawa and Twin Lakes for wildlife species.	1) Do site specific analysis to determine if clearcuts between the two LSR's are effecting low mobility species movement	C
<b>Unique Habitats and Species</b>	1) Reduce road and trail densities in riparian reserves, talus, meadows and wetlands.	Close or relocate roads and trails as opportunities are identified in Access and Travel Management Planning.	A
	2) Maintain existing meadows. Wet, dry and subalpine meadows.	2) Remove encroaching conifers from meadows. - Reduce noxious weed spread in meadows and natural openings.	C
	3) Increase the amount of interior forest area within the LSR.	3) Close roads near interior forest areas as opportunities are identified through Access and Travel Management Planning. - Accelerate late successional forests.	A
	4) Retain: whitebark pine acreage within the LSR. (Garland Peak	4) prescribed fire.	C

Analysis Module	Restoration Opportunity	Potential Projects	Schedule 1
	spotted owl core areas.	center. --No Ground or vegetation disturbing activity in 13 of the 19 core areas (See list of spotted owl core areas with less than 500 acres of nesting habitat).	
	3) Rehabilitate or accelerate habitat recovery around spotted owl circle 506, 509 and 510.	3) Plant DF in activity centers.  3.1) Fertilize young trees to accelerate growth.	A  C
	4) Improve sustainability of dense dry forest (type 12) outside of 1.8 mile spotted owl circles within the LSR.	4) Use commercial thinning, pruning, and fuelwood collection. (Chikamin flats area and area from twin Creek to Fish Lake.)	A
	5) Improve sustainability of dense dry forest (vegetation Type 12) within 0.7 to 1.8 mile home range area on threshold acres. Treatment should maintain suitability of habitat for nesting, roosting and foraging. (see spotted owl desired conditions)	5) Utilize commercial thinning, pruning and fuelwood collection. -- 1st on non-suitable habitat, then on dry/mesic habitat. -- Use Stand Ranking System for spotted owls and for risk..	A
	6) Improve habitat quality in dense single story stands in spotted owl circles 510, 638, 645, 649.	6) Utilize silvicultural activities that accelerate the development of multi-layered stands. Focus on single layered pole size stands in moist grand fir and wet forest groups.	C
	7) Obtain information on spotted owl locations.	7) Survey areas to 1994 spotted owl protocol. See monitor list in individual owl section above.	B
	8) Decrease fragmentation.	8) Acquire fragmented private/state lands strategic to owl home ranges and connectivity. --Monitor/maintain connectivity within LSR..	
	9) Improve habitat effectiveness.	9) Reduce road densities, increase security habitat.	
	10) Habitat mapping/analysis	10) Field verify habitat maps and spotted owl activity home range acres.	
<b>Aquatic</b>	1) See goals listed in Aquatic section for Chiwawa LSR.	1) Coordinate projects with Entiat Watershed Assessment.	
<b>Noxious Weed</b>	1) Limit the extent and spread of <i>Centaurea diffusa</i> in twenty five mile creek area.	1) Consider treatments such as hand pulling and herbicides to limit extent and spread. Focus should be in high recreation use areas, particularly where stock are used such as Rock Creek Horse Camp.	B
	2) Control or eradicate <i>Cytisus scoparius</i> , <i>Cynoglossum</i>	2) Use combination of treatments such as hand pulling, and spot	A

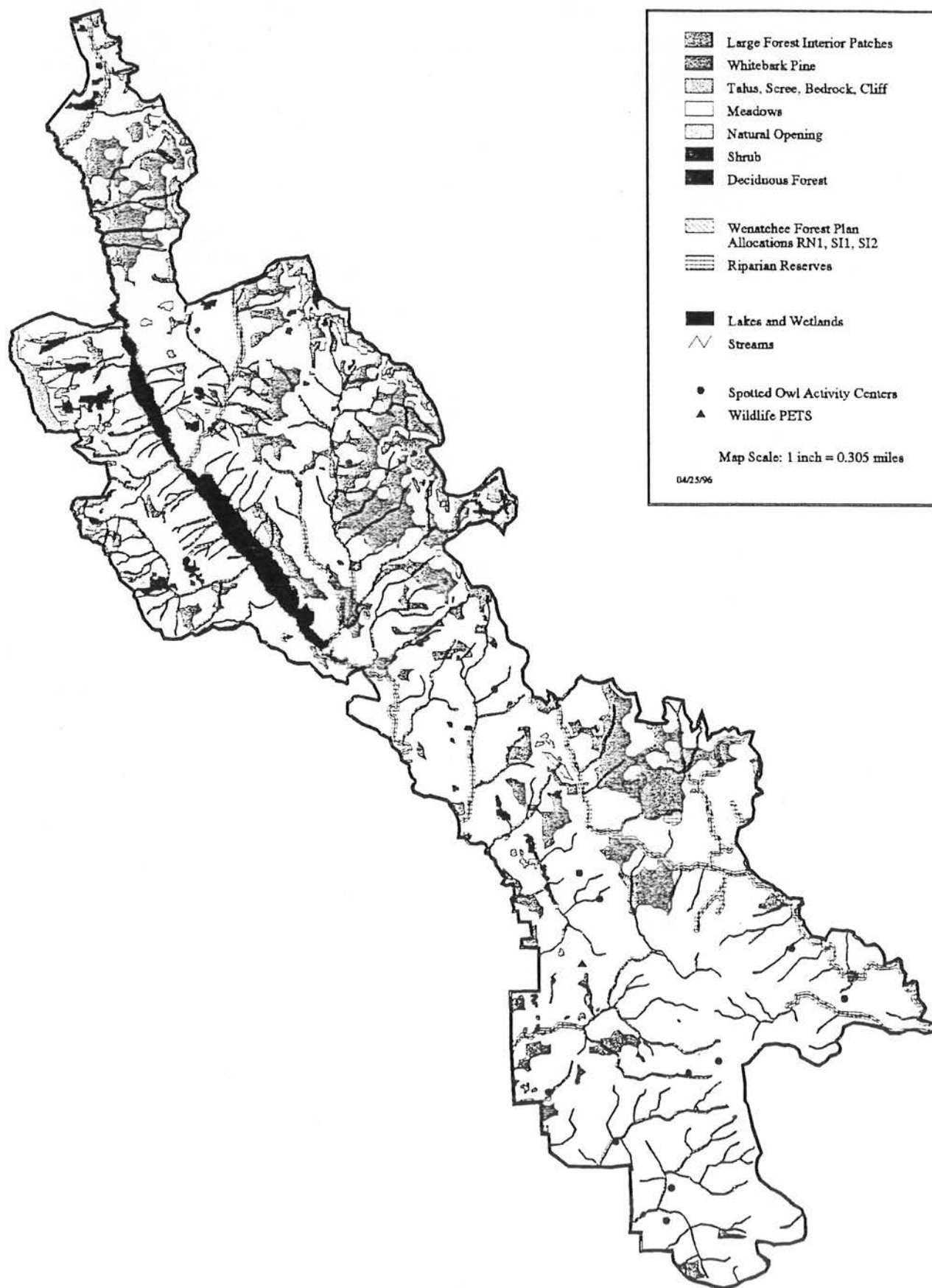
- Pole sized stands in wet/moist will be habitat in 50 years.
  - Clear cuts in mesic/dry vegetation groups will be habitat in 120 years.
  - Pole sized stands in mesic/dry will be habitat in 70 years.
3. Aggressive protection of remaining suitable spotted owl habitat, from outside LSR, on Matrix lands, Meadow Creek and Van Creek..
  4. Protect spotted owl home ranges within LSR, between owl circles, by implementing risk reduction on first on non-suitable habitat, then on Dry and Mesic habitat:
    - Twin Creeks to Goose Creek.
    - Clear Creek to Miners Creek (if owls did not relocate to these sites, as result of Tyee burn).
    - Lower Chikamin.
  5. Fuels reduction and hazard reduction occur outside N/R/F habitat in short term, shift emphasis in 50 years. Accept more risk from fire, manage at high end of spotted owl habitat DC. Spotted owl habitat maintained at 60% of home range in "big 3 LSR's, 500 Acre core area protected, 100 acre activity center protected.
  6. Monitor/maintain connectivity outside LSR at Glacier Peak Wilderness, Twin Lakes, Beaver Creek, Cromwell, Upper Tommy Creek, Whistling Pig Creek, 3-Creeks, and Pomas Creek.
  7. Acquire DNR sections at Alder Creek and upper Chumstick (for spotted owl N/R/F habitat) and on Miners Ridge.(for great gray owl, lynx, and connectivity habitat). Acquire lands in Chikamin Flats (connectivity and risk reduction) and Phelps Creek (connectivity to Wilderness).
  8. Monitor spotted owl activity centers, 500 acre core and home ranges of owls affected by Tyee fire: SO506\*, SO509\*, SO510\*, SO512, SO514, SO627\*, SO634, SO638\*, SO645\*,and SO649\*. (\* Acres below Threshold highest priority.)
  9. Monitor spotted owl activity centers, 500 acre core and home ranges of owls below threshold (see list).
  10. Field verify habitat within 500 acre home ranges of spotted owl sites below threshold in that core, but above threshold in the home range: SO605, SO 638, SO 649.
  11. Increase habitat effectiveness and connectivity by reducing open roads and revegeting road beds. Especially in forest interior habitat patches.
  12. Reduce road densities in: Lower Mad (4.91 mi./sqmi); Beaver Creek (3.9 mi./sq. mi.); Lower Chiwawa (3.8 mi./sq. mi.); and Middle Mad (3.42 mi./sq. mi.).
  13. Maintain dispersal/connectivity habitat (Cougar Creek, Jimmy Creek to Berg Creek, Maverick Saddle to upper Goose Creek, Chikamin Creek, Willow Creek, Rock Creek, from Grouse Creek west to Phelps Creek, Beaver Creek, and Chumstick Creek to Dry Creek to Second Creek).

*Vegetation in  
Chiwawa LSR*



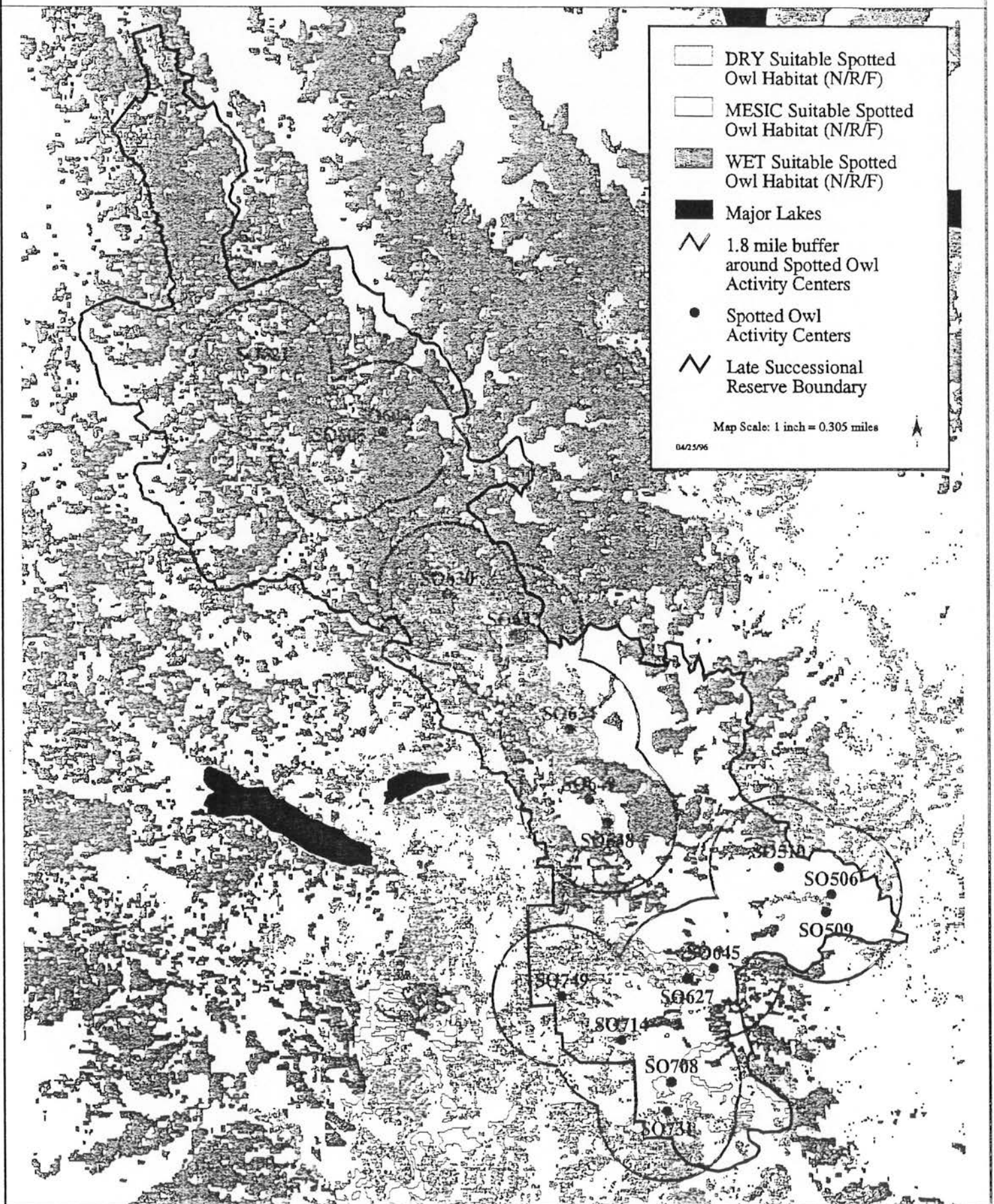
# *Chiwawa Late Successional Reserve*

## **UNIQUE HABITATS**



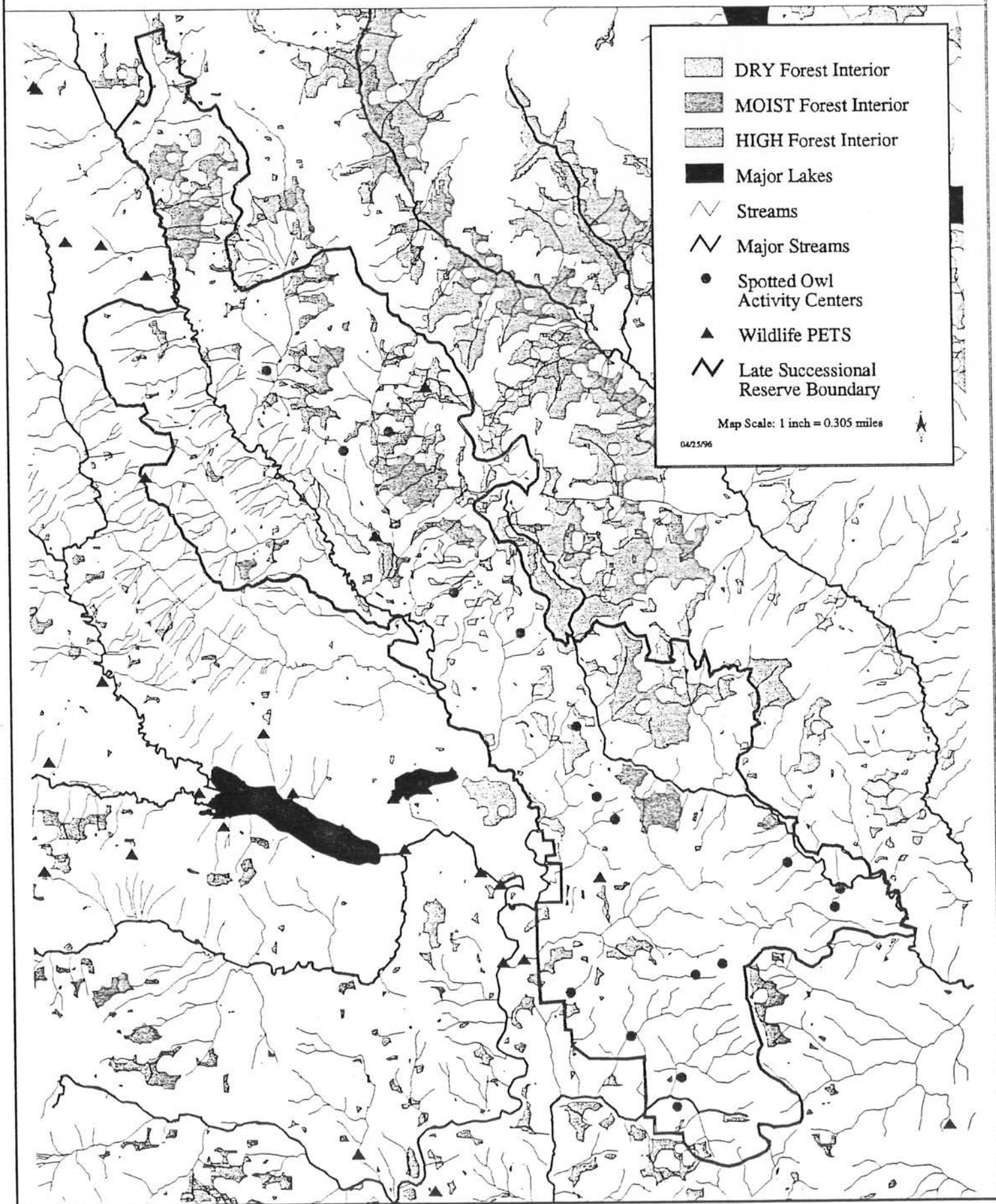
*Chiwawa Late Successional Reserve*

# *SUITABLE SPOTTED OWL HABITAT*



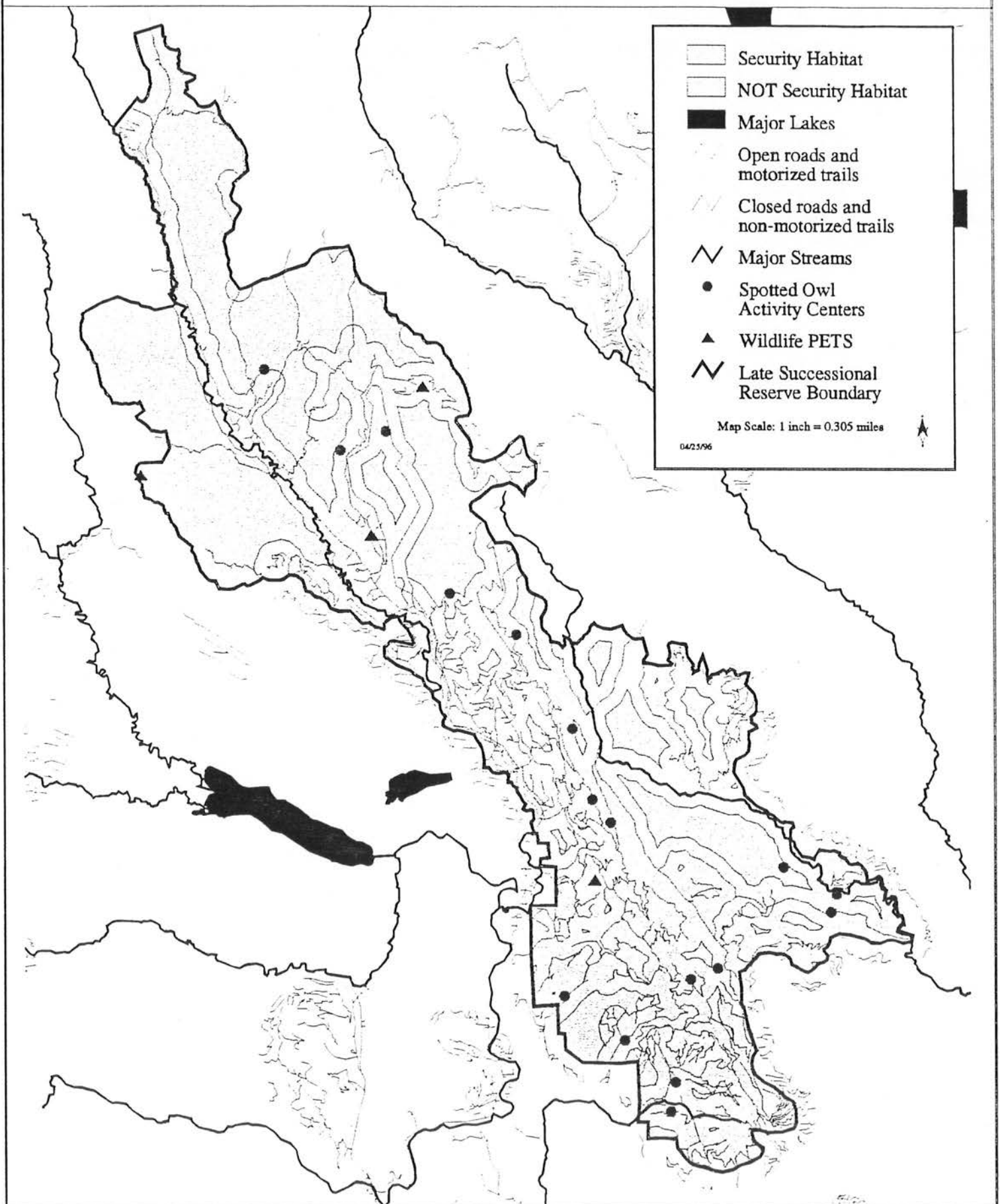
# *Chiwawa Late Successional Reserve*

## **FOREST INTERIOR**



# *Chiwawa Late Successional Reserve*

## ***SECURITY HABITAT***



# Chiwawa Late Successional Reserve

## FISH PRODUCTION UNITS (SUBWATERSHEDS)

